WEST VIRGINIA
GEOLOGICAL SURVEY

Digitized by the Internet Archive
in 2012 with funding from
LYRASIS members and Sloan Foundation

http://www.archive.org/details/marshallwetzelty00west

GEOLOGICAL SURVEY

COUNTY REPORTS AND MAPS

Marshall, Wetzel and Tyler Counties

BY

RAY V. HENNEN, Assistant Geologist

I. C. WHITE, State Geologist

The Acme Publishing Company
Printers and Binders
Morgantown
1909

GEOLOGICAL SURVEY COMMISSION.

WILLIAM E. GLASSCOCK.....*President*

GOVERNOR OF WEST VIRGINIA.

E. L. LONG.....*Vice President*

TREASURER OF WEST VIRGINIA.

ARCHIBALD MOORE.....*Secretary*

PRESIDENT STATE BOARD OF AGRICULTURE.

D. B. PURINTON.....*Treasurer*

PRESIDENT WEST VIRGINIA UNIVERSITY.

JAMES H. STEWART.....*Executive Officer*

DIRECTOR STATE AGRICULTURAL EXPERIMENT STATION.

STATE OF WEST VIRGINIA
JUNE
20
1863
MONTANI SEMPER LIBERI

SCIENTIFIC STAFF.

I. C. WHITE.....*State Geologist*
SUPERINTENDENT OF THE SURVEY.

G. P. GRIMSLEY.....*Assistant Geologist*

RAY V. HENNEN.....*Assistant Geologist*

C. E. KREBS.....*Assistant Geologist*

D. B. REGER.....*Temporary Field Assistant*

A. B. BROOKS.....*Forester*

B. H. HITE.....*Chief Chemist*

J. B. KRAK.....*Assistant Chemist*

EARL M. HENNEN.....*Chief Clerk*

J. L. WILLIAMS.....*Stenographer*

LETTER OF TRANSMITTAL.

To His Excellency, Hon. William E. Glasscock, Governor of West Virginia, and President of the State Geological Survey Commission:

Sir: I have the honor to transmit herewith the Detailed Report of Mr. Ray V. Hennen on the counties of Marshall, Wetzel and Tyler. This is the second volume of the Survey publications dealing with the detailed geology of county areas, the first one, describing the counties of Ohio, Brooke and Hancock, having been published under date of April 15, 1907, by Prof. G. P. Grimsley. These detailed Reports describe every economic feature of each county, including not only its coals, their quality and quantity, its oil and gas developments, its limestones, building stones, clays, ores and all of its other mineral wealth, but also its soils, their quality, and what crops they are most fitted to grow, as also the kind of fertilizers best adapted to improve them. The Survey has entered into a cooperative arrangement with the U. S. Department of Agriculture's Bureau of Soils at Washington, by which the services of the soil experts of that Bureau are secured to study and map the different soils of the State at only a slight cost, practically one dollar per square mile, the cost of analyses, preparation of the soil report, and engraving the maps all being defrayed by the U. S. Department of Agriculture. The West Virginia Geological Survey is permitted to make use of the same lithographic stones in printing its issue of soil maps without additional cost for engraving and thus a considerable economy is effected.

Mr. Hennen has introduced a new feature on the geologic map which accompanies this volume; viz., showing the geologic structure by contours on the horizon of the *Pittsburg coal*, which exhibit its approximate elevation above tide level, thus giving a valuable guide not only to those who are interested in mining this great fuel bed, but also to those engaged in the search for petroleum and natural gas, since in this region of the State the underlying oil and gas sands while not exactly conformable to the dips and rises of the Pittsburg coal, are practically the same. The large number of oil and gas well records published in the

text as also their exact locations as given on the geologic map of the district, cannot fail to prove of great future value to the mining interests of the State, since they indicate with more or less exactness not only where the Pittsburg coal is absent, but also where the Sewickley, Uniontown and higher beds are present in commercial thickness. In the not very distant future when the Pittsburg coal is reaching exhaustion, these records thus preserved from loss will prove of great economic value. The assembling of the several topographic sheets of the district into one map of the three counties showing the roads, streams, topography, tidal elevations, and correct locations of all the farm houses, school houses, churches, villages, towns, etc., cannot fail to prove of great service to every interest in this area, and to none more than to those of agriculture. Such maps are indispensable to the county authorities and the State Road Commissioner in planning permanent improvements to the highways of the State. This Report and the accompanying atlas of maps speak for themselves as to the vast amount of labor Mr. Hennen has expended upon this district, and the masterly and skillful manner in which he has assembled his data for the benefit of the reader. During the present field season Mr. Hennen will make a similar study of the counties of Calhoun, Wirt and Roane, the results of which should be published early in 1910.

The present Report on the counties of Wetzel, Marshall and Tyler by Mr. Hennen will be followed by another of similar character in two or three months, on the counties of Pleasants, Wood and Ritchie by Prof. G. P. Grimsley.

Mr. C. E. Krebs. the newly appointed Assistant Geologist, is making a detailed study of the geology of Mason, Jackson and Putnam counties, and his Report on that area will be published some time next year (1910).

Very respectfully,

I. C. WHITE, State Geologist.

Morgantown, October 1st, 1909.

CONTENTS.

PAGE.

Members of Geological Survey Commission III
Members of Scientific Staff V
Letter of Transmittal VI
Table of Contents VIII
Author's Preface XVI

PART I. HISTORY AND PHYSIOGRAPHY OF THE MARSHALL-WETZEL-TYLER AREA.

Chapter I.—Historical and Industrial Development 1-31

Location and History 1- 3
History of Transportation 3- 5
Ohio River 3
Baltimore and Ohio Railroad 3
Ohio River Railroad 4
West Virginia Short Line Railroad 4
Prospective Railroads 5
General Description 5-31
Marshall County 5-17
Towns and Industries 5-17
Wetzel County 17-26
Towns and Industries 17-26
Tyler County 26-31
Towns and Industries 26-31

Chapter II.—Physiography of the Marshall-Wetzel-Tyler Area 32-58
Physiographic Changes 32-40
Description of Drainage Basins 40-47
Topography of the Land Area 48
River Terraces 48-50
Creek Terraces 50-52
Ohio River 53-58

PART II. GEOLOGY OF THE MARSHALL-WETZEL-TYLER AREA.

Chapter III.—Geologic Structure 59-73
Introduction 59
Method of Representing Structure 60-62
Detailed Geologic Structure 62-73
Hundred Anticline 63
Burchfield Syncline 64
Littleton Anticline 64
Nineveh Syncline 65
Washington Anticline 66
Loudenville (Finney) Syncline 67
New Martinsville Anticline 68
Proctor Syncline 68
Robinson Syncline 69
Big Moses Anticline 69
Middlebourne Syncline 70
Wick Anticline 71
Shiloh Syncline 72
Sistersville Anticline 72

Chapter IV.—General Geology of the Marshall-Wetzel-Tyler Area 74-257
Introduction 74
Table of Geological Formations 75- 76
General Sections 77-123
Marshall County Sections 77- 97
Wetzel County Sections 98-113
Tyler County Sections 114-123
Dunkard Series 124-257
Pennsylvania Sections 126-129
Marshall County Sections 131-148
Wetzel County Sections 148-158
Tyler County Sections 159-165
Description of Formations 166-248
Age of Dunkard Series 249-257

Chapter V.—Monongahela Series 258-312
Geologic Sections 258-281

Description of Formations..... 282-312
Chapter VI.—Conemaugh Series..... 319-325
General Account and Sections..... 319-324
Description of Formations..... 325
Chapter VII.—Allegheny Series..... 326-338
General Account and Sections..... 326-334
Description of Formations..... 335-338

PART III. MINERAL RESOURCES OF THE MARSHALL-WETZEL-TYLER AREA.

Chapter VIII.—Petroleum and Natural Gas..... 339-533
Oil and Gas Horizons..... 339-340
Description of Sands..... 341-358
Murphy sand..... 341
First Cow Run sand..... 342
Dunkard sand..... 343
Gas sand..... 344
Second Cow Run sand..... 344-345
Salt sand..... 345-346
Maxton sand..... 346-347
Big Injun sand..... 347-350
Berea Grit sand..... 350-351
Gantz sand..... 351-352
Fifty-foot sand..... 352
Thirty-foot sand..... 352-353
Gordon Stray sand..... 354
Gordon sand..... 354-356
Fourth sand..... 356-357
Fifth sand..... 357
Bayard or Sixth sand..... 357-358
Speechley sand..... 358
Oil and Gas Development, etc..... 359-532
Early History..... 359-360
Marshall County Well Records..... 360-402
Table of, summarized..... 364-369
Union and Sand Hill districts..... 370-375
Webster district..... 375-378
Washington district..... 378-380

Cameron district..... 380-381
Liberty district..... 381-391
Meade district..... 392-398
Clay district..... 398-400
Franklin district..... 401-402
Wetzel County Well Records..... 402-472
Table of, summarized..... 404-417
Church district..... 418-435
Clay district..... 435-440
Center district..... 440-445
Grant district..... 445-460
Green district..... 460-466
Proctor district..... 466-471
Magnolia district..... 471-472
Tyler County Well Records..... 472-532
Table of, summarized..... 476-487
Lincoln district..... 475-493
Union district..... 493-500
Ellsworth district..... 500-510
McElroy district..... 510-520
Centerville district..... 520-524
Meade district..... 525-532
Effect of Geologic Structure on Oil and Gas Distribution..... 532
Prospective Oil and Gas Territory..... 533

Chapter IX.—Coal Resources of the Marshall-Wetzel-Tyler Area..... 534-581
Statistics of Coal Production..... 535-537
Coals of the Marshall-Wetzel-Tyler area..... 538
Diagram showing relative position..... 539
Dunkard series..... 540-553
Washington coal..... 540-553
Table showing thickness..... 551
Quantity of Available..... 552
Monongahela series..... 553-575
Waynesburg coal..... 553-558
Table showing thickness..... 557
Quantity of Available..... 558

Uniontown coal..... 558
Table showing thickness..... 559
Quantity of Available..... 561
Sewickley coal..... 561-565
Table showing thickness..... 562-564
Quantity of Available..... 564-565
Pittsburg coal..... 565-575
Commercial mines in..... 566-574
Quantity of Available..... 574-575
Allegheny series..... 576-577
Lower Freeport coal..... 576-577
Summary of available coal in the three counties.... 577
Table showing chemical composition of the coals in the Marshall-Wetzel-Tyler area..... 578-579

Chapter X.—Clays, Road Materials and Building Stone 582-598

Clay and clay industry..... 582-589
Road materials..... 589-592
Building stone..... 592-598

Chapter XI.—Soil Survey of Marshall, Wetzel and Tyler Counties, W. Va., by Thos. A. Caine, E. R. Allen, H. Jennings, and G. W. Tailby, Jr...... 599-635

Description of the area..... 599-603
Climate..... 603-605
Agriculture..... 605-611
Soils..... 611-633
Dekalb loam..... 614-616
Dekalb silt loam..... 616-618
Wheeling silt loam..... 618-620
Wheeling gravelly loam..... 620-621
Wheeling sandy loam..... 622
Tyler silt loam..... 622-624
Huntington loam..... 624-625
Huntington fine sandy loam..... 625-627
Meigs clay loam..... 627-629
Brooke clay loam..... 629
Upshur clay..... 629-631

Rough stony land 631-633
Summary 633-635

Appendix.—Levels Above Mean Tide in the Marshall-Wetzel-Tyler Area 636-643

Index 644-654

ILLUSTRATIONS.

Maps in Atlas.

Topographical Map of the Marshall-Wetzel-Tyler Area.

Map showing Economic Geology and Structure Contours of Pittsburg Coal.

Soil Map of the Marshall-Wetzel-Tyler (Middlebourne) Area.

Plates.

No. PAGE.

I.—The Mammoth Mound at Moundsville, Marshall County, W. Va. 8

II.—Owlshead Knob at Jacksonburg, Wetzel County.... 24

III.—Showing Break-through at Neck of the Famous "Jug" of Middle Island Creek, Tyler County..... 46

IV.—Showing Steep Bluffs Along the Ohio River Front of Marshall County, N. E. from the Mouth of Hog Run near Powhatan Station..... 56

V.—Ohio River Bottom Land in the Southeast Corner of Marshall County, North from Proctor..... 96

VI.—View of Tyler County Topography, Looking Westward from the Summit of Owlshead Knob, same County 160

VII.—Batson Quarry in Hundred Sandstone, Two Miles Below Hundred, Wetzel County..... 214

VIII.—Coal Mine in the Sewickley Bed at Mouth of Hog Run, ½ Mile Northeast of Powhatan Station..... 308

IX.—Largest Natural Gas Pumping Station in the World, Located at Hastings, Wetzel County..... 448

X.—Showing Oil Wells Along the Steep Hillsides in the Wick Field of Tyler County..... 472

XI.—Showing Method of Pumping Oil Wells (J. S. Riggs No. 2), McKim Field, Tyler County..... 508

XII.—J. W. Ankrom No. 6, the Largest Big Injun Sand Oil Well in the McKim Field, Tyler County..... 528

Figures.

No.		PAGE.
1.	Cross Section of the Ohio River Channel at Dam No. 11, below Wellsburg	55
2.	Cross Section of the Ohio River Valley at Glenova, Showing Outcropping and Underground Strata, 6½ Miles North from the Ohio-Marshall County Line	331
3.	Diagram Showing the Relative Position of the Coals in the Marshall-Wetzel-Tyler Area	539

AUTHOR'S PREFACE.

In the preparation of this report on Marshall, Wetzel and Tyler counties it has been the purpose of the author to present the salient features of their geology and state the facts in a style intelligible not only to the residents of the area, but to the people of the State without losing sight of scientific accuracy.

The object of this report is to assemble the present knowledge of the economic resources of the Marshall-Wetzel-Tyler area, including also a large amount of hitherto unpublished data collected by the writer in the field, and to present it in a convenient form for the use of those who are interested in their development.

The report gives (1) a brief history of the counties and their industrial development; (2) a study of the surface features or their physical geography; (3) the geologic structure, with a contour map of the Pittsburg coal bed; (4) four chapters on the general and detailed geology of the area; (5) the oil and gas fields of the three counties with suggestions for their further development; (6) the coal resources and the chemical composition of the coal; (7) clays, road material and building stone; and (8) a chapter on the soils of the three counties.

One of the most important features of this report is the determination and representation of geologic structure. The depth of the Pittsburg coal horizon has been determined all over the area and a contour map constructed to show how it lies. These contours are shown on the economic geology map accompanying the report in a separate cover. By referring to this map the depth to the Pittsburg coal horizon can be told approximately at a glance, and the shape and location of the anticlines and synclines, a knowledge of which is of the greatest importance in the development of the oil and gas pools, and also for the future mining of the several coal beds when of commercial thickness and purity.

The chapters on the general and detailed geology, while somewhat of a technical nature, give more detailed informa-

tion concerning the formations of the Dunkard series in West Virginia than hitherto published. These chapters also give the generally accepted classification of the rock strata which permits comparison with the formations in other counties and states.

The chapter on oil and gas gives the logs of a large number of wells bored for these minerals not heretofore published, thus preserving from loss a large fund of information concerning the depth and thickness of the several coal beds.

The chapter on coals shows the character, thickness and chemical composition of the several coal beds, along with an estimate by the writer of the available tonnage and probable area of each commercial coal seam in the three counties with a final summary of the total available commercial coal in the Marshall-Wetzel-Tyler area.

The chapter on clays, road materials and building stone is also of interest, and lastly but not least the chapter on soils cannot fail to interest the progressive farmers within the area. The latter was prepared by Thomas A. Caine, E. R. Allen, H. Jennings, and G. W. Tailby, Jr., of the Bureau of Soils at Washington, D. C., all well trained men with practical experience in soil study.

Three maps of the entire area accompany this report in a separate cover, one of which shows by the use of colors the character of the surface, the roads, streams, railroads, etc.; another illustrates the economic geology by showing the outcrops of coal beds, mines, oil and gas wells, dry holes, structure contours of the Pittsburg coal, and the approximate western boundary line where the latter of commercial thickness and purity disappears; the third, or soil map, shows by the use of colors the character and distribution of the soils.

The writer devoted part of two field seasons in gathering data for this volume, and received much valuable assistance from individuals and officials of the various companies engaged in the development of the coal, oil and gas resources of the area. In the body of the volume due credit and acknowledgment has been given for all such data obtained such as oil and gas well records, diamond drill borings, etc.

The chemical analyses were made in the Survey laboratory by Mr. Leicester Patton and Mr. J. B. Krak, assistant chemists, under the direction of the chief chemist, Prof. B. H. Hite.

The writer takes this opportunity to express his obligation to Dr. I. C. White, State Geologist, whose writings and suggestions have added very much to the value of this report.

Ray V. Hennen.

Morgantown, W. Va., October 1st, 1909.

PART I.

The History and Physiography of the Marshall-Wetzel-Tyler Area

CHAPTER I.

THE HISTORICAL AND INDUSTRIAL DEVELOPMENT

LOCATION AND HISTORY.

The portion of West Virginia taken up in this report includes the area surrounding the southwest corner of the state of Pennsylvania, Marshall county, forming the base of the northern Panhandle of West Virginia, and Wetzel and Tyler counties immediately adjoining on the south and extending on down the Ohio river front to a point about 9 miles southwest of Sistersville. The three counties include an area of 935.85 square miles as follows: Marshall, 315.26; Wetzel, 360.47; and Tyler, 260.12 square miles.

Since a portion of this area is included in the northern Panhandle of West Virginia, it will be of interest here to quote from Prof. G. P. Grimsley's report[1] as follows:

"The explanation of this peculiarly shaped northward extension of the state is to be found in the history of the original land grant to William Penn. It was finally marked out by the

1. Ohio, Brooke and Hancock County Report, page 1.

survey of the Mason and Dixon line and by the settlement of the boundary disputes between the states of Pennsylvania and Virginia. The tract was named the "Panhandle" in the course of legislative debate, by Hon. John McMillan, a delegate from Brooke county.

"It was in the year of 1767 that the south line of Pennsylvania was surveyed by the two English engineers, Mason and Dixon, who were ordered to establish a line westward for five degrees of longitude from a starting point fixed on a circle forming the north boundary of the state of Delaware. This survey was carried west to a point near the present town of Mount Morris, west of the Monongahela, where the line was terminated on account of the hostility of the Indians. The two engineers calculated the line should be continued westward 23 1-4 miles, and the work was left incomplete.

"The territory of the Pan-handle was then claimed by Pennsylvania and Viriginia, both states granting deeds which later led to serious disputes. In 1780 a commission was appointed by Pennsylvania and Virginia to settle the doubtful southwestern corner of Pennsylvania and establish the boundary lines between the two states. The members of the commission agreed to fix the boundaries by a line drawn at five degrees of longitude west from the Delaware river, thence north to the northern boundary of Pennsylvania. The corner was carefully established, and the northward line surveyed to the Ohio river, where the work stopped on account of hostility of the Indians.

"The report of the commission was submitted to the two states in December, 1784, accepted and adopted by the Legislature of Virginia on October 8, 1785, and from that date the Pan-handle has been legally a part of Virginia."

In November, 1776, the district of West Augusta, which included most of the present territory of West Virginia west of a line drawn south from the western boundary of Maryland, was sub-divided into three districts or counties: Youghiogheny, Ohio and Monongalia.

Ohio county included the territory south of Cross creek (center of present Brooke county), and west of the dividing ridge between the waters of the Ohio and Monongahela, and

north of a line drawn between the headwaters of Cheat and Greenbrier rivers, continued westward to the Ohio river. The present Marshall-Wetzel-Tyler area is included entirely within the limits formerly covered by Ohio county. In 1835 Marshall county was formed from the southern part of Ohio county; in 1814 Tyler county was formed from a portion of Ohio county; and in 1846 Wetzel county was formed from the northern part of Tyler.

HISTORY OF TRANSPORTATION.

Ohio River.

Long before the steam railroad was thought of, the value of the Ohio river as a carrier of trade attracted attention, and cities sprang up along its banks. Even now the attention of the National Congress is directed towards making a complete connected chain of locks and dams from Pittsburg to Cairo.

The three most important Ohio river towns in the Marshall-Wetzel-Tyler area are Moundsville, New Martinsville and Sistersville. All three are thriving towns and their description will be taken up later in this report. Capt, F. W. Alstaetter of the U. S. Engineer Office at Wheeling, W. Va., says that according to statistics compiled by Col. W. T. Rossell, Corps of Engineers, 11,306,544 tons of general merchandise, coal, etc., and 4,414,213 passengers were carried during the calendar year 1907 on the Ohio river. Also the wharf-boat owners state that 110,000 tons of freight were handled and 40,100 passengers were carried in and out of Wheeling during the year 1908.

Baltimore & Ohio Railroad[2]

The main line of the Baltimore & Ohio Railroad runs entirely across the central portion of Marshall county in a southeast-northwest direction, and on across the northeast corner of Wetzel county.

"The plan of building a railroad from Baltimore to the

2. Ohio-Brooke-Hancock Report, page 5.

Ohio river was first proposed at a meeting of business men in Baltimore, February 27, 1827, fixing the capital stock at $3,000,000 in 30,000 shares of $100 each.

"The board of directors was organized April 23, 1827, the work of construction commenced, and the road was opened to Frederick, Maryland, December 1, 1831. The line was completed to Cumberland, November 5, 1842, and no further work done until 1849, when the construction was resumed westward and completed to Wheeling, January 1, 1853.

"The Parkersburg branch was completed in 1857, and in 1871 the B. & O. purchased the "Hempfield" railroad, operating a line from Wheeling to Washington, Pa., and completed the road to Pittsburg, several years later.

"The Central Ohio railroad was chartered in Ohio in 1848 opened from Zanesville to Newark in 1849, and continued to Columbus in 1850. In 1852 terminal facilities were acquired in Wheeling. The road was leased by the B. & O. in 1865, and the Bellaire bridge completed in 1871.

Ohio River Railroad.

"The charter for the Ohio River railroad was issued in April, 1881, under the name of the Wheeling & Parkersburg railroad, but received its present name in December, 1882. The railroad was completed to Benwood in June, 1884, the trains running into Wheeling over the Pittsburg, Wheeling and Kentucky tracks. The river road reached Point Pleasant in January, 1886, and Huntington in April, 1888. This road is now operated by the Baltimore & Ohio."

This railroad extends entirely along the Ohio river front of Marshall, Wetzel and Tyler counties, and in addition to a fair freight tonnage, has an unusually heavy passenger traffic. This road was purchased by the B. & O. Railway Company in 1901, and has been operated by the latter since that time.

West Virginia Short Line Railroad.

This road extends from New Martinsville southeast up Fishing creek to its head entirely across Wetzel county for a

distance of 36 miles, and continues on southeast in Harrison county to Clarksburg the total length being 60 miles. It is a very important connecting link and has aided very much in the development of the great oil and gas fields of central and eastern Wetzel county. It will also play a very important part in the future development of the Pittsburg coal field of eastern Wetzel and western Harrison counties.

The construction of this road was begun about 1900 and completed in 1902. It was turned over to the B. & O. at the time of the purchase of the Ohio River Railroad by the former company.

Prospective Railroads.

The Wabash Railroad recently made a survey up Wheeling creek, southeast from Elm Grove, Ohio county via Majorsville, across the northeastern corner of Marshall county to form a connecting link between the Wheeling & Lake Erie and the Western Maryland, both being subsidiary branches of the Wabash at the time of the survey. The B. & O. has also made a survey down the same stream, parallelling that of the Wabash, both roads making an effort to get a shorter road than already exists from the Wheeling steel mills to the Fayette county, Pennsylvania, coke fields. It seems sure that this portion of Marshall is destined to get one if not two railroads in the near future. In fact such a road would traverse along its entire route from Wheeling to the Monongahela river one of the greatest undeveloped coal fields in America, since the famous Pittsburg bed, the Sewickley, and the Waynesburg coal seams all underlie this region.

GENERAL DESCRIPTION.

Marshall County.

Marshall county is situated at the base of the northern Pan-handle of West Virginia and borders on the Ohio river for a frontage of about 27 or 28 miles.

Its area given by districts as computed from the accurate topographic maps of the U. S. Geological Survey is as follows:

Districts	Sq. Miles
Union	26.05
Sand Hill	26.77
Webster	36.26
Washington	26.33
Cameron	31.45
Clay	26.14
Liberty	53.06
Meade	58.87
Franklin	50.33
Total	315.26 sq. miles

It varies in elevation from 591 feet above tide at the Ohio river in the southwestern corner of the county to 1590 feet at the top of a high knob just south of Rocklick and 3 1-2 miles northeast of Cameron. A range in elevation of 1000 feet. [3]The population in 1900 was 26,444 of which 25,941 were white, 499 colored, and 1264 foreign born. The mean magnetic declination in 1900 was 1 degree and 50 minutes West.

Marshall county began its existence March 12, 1835, when the General Assembly of Virginia enacted "That all that part of the county of Ohio, lying south of a line beginning on the Ohio river at a stone to be fixed on the bank of said river, one-half mile above the mouth of Boggs run, thence a direct line to the northern boundary of the town of West Union, thence continuing the same course to the Pennsylvania line, shall form one distinct and new county, and be called and known as Marshall county." The county was named in honor of John Marshall, Chief Justice of the United States.

The act made Elizabethtown, (now Moundsville) the county seat, and the first court for the county of Marshall met in a brick school house in this town in May, 1835.

This county has long been a rich agricultural area, es-

3. Bulletin 233, U. S. Geological Survey, page 98.

pecially north of an east and west line through the mouth of Fish creek. South of this line, however the hills are higher, steeper and rougher and better adapted to grazing than to tillage. The farmers are engaged in the raising of wheat, corn, oats, fine cattle, horses, sheep and hogs. The quality and character of the soil as well as its products will be taken up under a separate chapter of this report, as also the mineral wealth in the line of coal, oil and gas.

The State Auditor gives the following valuations in Marshall county for the year 1908:

	Assessed Valuation	State Tax
Real Estate.....	$19,207,280.00	$9,613.67
Personal Prop'ty..	6,161,280.00	3,079.66
Total	$26,368,560.00	$12,693.33

There is no state tax assessed for school purposes. Each district makes its own assessment for maintenance of schools, both teachers' and building fund.

Marshall county's total assessed valuation in 1908 is almost one-half more than that for Wetzel county, and double that for Tyler. This is due largely to the better farms and the fact that the entire area of Marshall county is underlaid with the great Pittsburg coal seam.

Small towns are scattered over the county, and it is also well supplied with churches and public schools. The towns in the county are Moundsville, Benwood, McMechen, Glendale, Cameron, Denver, Glen Easton, Rosbys Rock, Londenville, Boardtree, Sherrard, Majorsville, Rocklick, Kausooth, Adaline, Lynn Camp, Graysville, Woodlands, Ella and St. Joseph.

Moundsville.

Moundsville the county seat and largest town in the county, is located on the Ohio river front at the mouth of Grave creek. The first settlement was made here in 1771 by Joseph Tomlinson. In 1798,[4] January 13th, a ferry was established from

4. History of West Virginia by Virgil Lewis.

lands of Joseph Tomlinson, at the mouth of Little Grave creek, across the Ohio river. The same year a town was laid out by the owner of these lands and named Elizabethtown, in honor of his wife. The same was established by legislative enactment, January 18, 1803, with Joseph Biggs, Lazarus Harris, Jonathan Purdy, Jeremiah Woods and Jacob Wetzel, trustees. In 1831, the town of Moundsville was laid out by Simeon Purdy, and the same was established by legislative enactment, January 28, 1832. By act of the Legislature passed February 23, 1866, the towns of Moundsville and Elizabethtown were consolidated into one corporation under the name of the Town of Moundsville.

In 1900 the population was 5362, and at present is estimated at 7500 by J. E. Roberts, Asst. Postmaster of Moundsville. A large per cent. of the population is made up of retired farmers.

The Mammoth Mound. One of the great pre-historic mounds in America is located within the corporation boundary of Moundsville, and from it the town receives its name.

This mound is 245 feet in diameter at the base; 79 feet in height, with apex flat, and about 150 feet in circumference.

In his History of West Virginia, Hon. Virgil A. Lewis has the following to say about this mound:

"On cutting transversely the trunk of an oak that once crowned the summit, the concentric circles showed an age of 500 years. This mound was discovered by Joseph Tomlinson a short time after his location at the place."

The following article concerning this mound by Will de Hass of Philadelphia in a letter to the Public Press was taken from the Weston Independent under date of May 25, 1909:

"The legislature of West Virginia at its late session did a praiseworthy act in purchasing the great mound at Moundsville, one of the largest and most interesting prehistoric tumuli in central North America. This important mound has long interested scholars and antiquarians, and has also provoked controversy. A description and a statement of the controversy may not be uninteresting at this time. The tumulus is a typical structure of the mound period—conical symmetrical and 70 feet in height, covered with forest trees, some of primeval growth. It stands on a second terrace of a

Plate I.—The Mammoth Mound, at Moundsville, Marshall County, W. Va., (See Text).

of his investigations for Dr. Morton. Dr. Townsend, of Prof. Rodgers' geological staff, communicated to the Cincinnati Chronicle (monthly) a detailed account of the mound and discoveries. A pen drawing of the tablet accompanied by his sketch, which was used by Prof. Raflia, Baron Jomard and other European scholars, and not being entirely accurate, has been slightly misleading.

"Arthur I. Boreman, then a resident of Elizabethtown (Moundsville), communicated to the American pioneer a sketch of the mound, its explorations, and containing quite a good impression of the tablet. Mr. Boreman was the first Governor of West Virginia and later United States Senator.

"Mr. Schoolcraft visited the mound and made a painstaking and exhaustive examination, which he reported to the Ethnological society. His great work on Indian history and archaeology fully described the mound and contents. Other visitors and writers of distinction have published descriptions and opinions.

"The tablet was deposited temporarily in the Smithsonian Institute, where casts were made in wax, plaster, etc., and generally distributed. Professors Henry, Baird and Foreman were interested, and stimulated research in western archaeology.

"Of foreign savants who have written on the inscription, mention may be made of Professor Raflia, of the Society of Northern Antiquaries; the Baron Jomard, Sir. J. E. Alexander, Professor Wilson, Doctor Bing, the Marquis de Naidillac and others.

"In this country Mr. Schoolcraft, the Rev. Dr. Hawks, with scores of others have written on the subject. Our learned societies discussed it, and almost every work on American archaeology treated it.

"Several years after the discovery, E. G. Squire, who had been associated with Doctor Davis in preparing a work on the "Ancient Monuments of the Mississippi Valley," visited the mound, and in a capitous spirit discredited the tablet because anomalous. This opinion he repeated in a paper before the American Ethnological society. Citizens of Wheeling

and Moundsville, familiar with the facts of discovery, and investigators who had examined and expressed confidence in its authenticity, were indignant at Mr. Squire's attempted impeachment, and resolved to establish the authenticity of the tablet. The writer, then residing at Washington, was consulted, and accepted an invitation of the Ethnological Society to prepare for the society a paper embodying the facts and discussing fully the authenticity of the tablet.

"A meeting, comprising most of the prominent literary, scientific and professional men of New York City, was held, supplemented with a banquet at the residence of the president. A carefully prepared paper, with a mass of testimony authenticating the discovery of the tablet was submitted. Mr. Squire was present, and followed the speaker with a candid disclaimer of any intention to discredit the tablet. He was convinced by the facts presented, and moved a vote of thanks.

"The tablet is recognized by the linguists and archaeologists as a valuable discovery, but its true character has not yet been determined. It is probably a prayer, medal or legend. The character resembles the old Phoenecian as found along the Mediterranean. As other chambers have been discovered by the falling in of walls, it is hoped that further explorations may develop additional tablets and other important relics.

"In this connection it may not be inappropriate to state that an inscribed stone was taken from another mound of the Grave Creek system many years ago, and deposited in the museum of Hampden-Sydney college, Virginia. It cannot be found, but Doctor Marters, member of the house of delegates, who carried the relic to Richmond, testifies to the fact."

The same paper is also authority for the following data about the purchase of this mound by the State of West Virginia under date of May 25, 1909:

"The State Board of Public Works has received from Richard J. McFadden a deed transferring to the state the giant mound at Moundsville, which will be preserved as a memorial to the pre-historic race which constructed it centuries ago.

"The property had been purchased from the heirs of G.

S. McFadden for $25,000. Of this amount, $5,000 was donated by the heirs themselves in memory of their father, and $1,400 was contributed by school children of the state. The rest was appropriated at the last session of the legislature.

"In 1874 McFadden purchased the mound property, which takes up a city block in the heart of Moundsville. He was the first warden of the State Penitentiary at Moundsville and bought the mound to prevent a beer garden being established on it. Within the last few years the demand for the property for city lots was such that arrangements were being completed to remove the mound, and through the efforts of State Superintendent of Schools, Thomas C. Miller, the school children of the state started a fund to purchase the mound."

The Mammoth Mound is one of a series of mounds and other evidences that at some ancient time the place was occupied by a race superior to the savage tribes which the early settlers found in possession of it.

The main industries of Moundsville are the manufacture of glass ware, novelties, enameled ware, guns, ladies garments etc.

Moundsville is connected with Wheeling (via McMechen and Benwood) by an electric trolley road.

The Glass Industry.

The largest industry of Moundsville is that represented by the Fostoria Glass Company. This company employs 800 to 1000 people and runs the year round with the exception of a two or three weeks' shutdown for repairs. The company manufactures cut, pressed and blown table ware, bar goods, decorated lamps and novelties.

The next largest industry is that represented by the United States Stamping Company, and the Stewart Stamping Company. Both are engaged in the manufacture of enamel ware and employ 200 to 300 people each, the former being the larger of the two.

The U. S. Three-Barrel Gun Company. This company is engaged in the manufacture of a gun having 3 barrels, a com-

bination rifle and shot-gun. It employs 30 to 50 expert gun-makers.

The Blankensop Manufacturing Company run about 50 sewing machines, making ladies' garments, such as shirt-waists, dressing-sacks, etc.

There are a few smaller industries one of which is represented by **J. A. Schwob Company** which is engaged in the manufacture of grain-cradles and is one of the largest of its kind in the world.

West Virginia State Penitentiary.

The State Penitentiary is located at Moundsville. Shortly after West Virginia became a state, her convicts were confined in the county jail at Wheeling, and appropriations made from time to time to provide for them.

The Legislature passed a bill on February 16, 1866, providing for a State Penitentiary, the location being fixed at Moundsville. The erection of the building was begun in July of the same year. The institution cost the State $363.061.15.

[5]The daily average number of convicts, including both State and United States prisoners, is 1224 for the two years ending October 1st, 1908; during which time 712 State convicts were received and 617 discharged, and 235 United States convicts were received and 400 discharged, or a total of 947 convicts received and 1,017 discharged for the biennial period.

This institution is more than selfsupporting and paid into the Treasury of the State $25,000.00 for the two years, leaving a surplus of 69,627.18 on October 1, 1908.

The labor, which is hired out to contractors, manufactures brooms, leather whips, men's pants, overalls and shirts.

Benwood.

The next town of importance in Marshall county is Benwood, located at the northwest corner of the county along the Ohio river. It is about 640 feet above tide and in 1900

5. Report of Warden for 1907-1908.

had a population of 4511. A brief account of its industries follows.

The Iron and Steel Industry.

[6]"**The Riverside Plant of the National Tube Co.** was started in 1866 by Dewey, Vance & Co. It consisted of a bar mill and nail factory, manufacturing light rails, bars, nails, and was later incorporated by the Riverside Iron Co. In 1870 furnace A was built and placed in operation in February, 1872. The steel works were added in 1884, and in 1887 the tube mill was completed, making gas pipe, casing, boiler tubes, bedstead tubing, hollow brake tubes for railroad use. In 1885 the large plate mills were erected to manufacture skelp for the tube plant. Furnace B was first used in March, 1903. The company now employs 3000 men, with a blast furnace capacity of 700 to 800 tons a day. The skelp mill turns out 600 tons daily, and the tube mill 500 tons.

"**Semet-Solvay Company.** At the Riverside plant of the National Tube Works the Semet-Solvay Company has installed a by-product coking plant consisting of one battery of 60 retorts, three flues high, and a second battery of 60 retorts, four flues high. The retorts built of fire brick are 30 feet long, 16 inches wide and 5½ and 7 feet high. The smaller retorts hold 5.1 tons of coal each. The coal is charged from above through three openings, and the coal is leveled and unloaded by a traveling stoking machine. The coal yields 70 per cent coke, or 500 tons in 24 hours from the two batteries, and is used by the Riverside plant. The other products saved are gas, coal tar, ammonia and napthalene or oil of tar, which is shipped in iron tank cars to other plants of the company where it is refined and used for carburation.

"Connellsville coal is used with the following average composition:

---

6. Ohio-Brooke-Hancock County Report by Prof. G. P. Grimsley.

Moisture	0.54
Volatile combust matter	30.54
Fixed Carbon	59.68
Ash	9.24
Sulphur	0.98
Phosphorus	0.013

"The coke manufactured shows the following composition in the sample selected, though this coke was not made from the car of coal analyzed. An analysis of standard Connellsville coke made in bee-hive ovens is added for comparison.

	By-product coke.	Connellsville coke
Volatile combustible matter	1.95	1.31
Fixed carbon	87.17	86.88
Ash	10.88	11.54
Sulphur	0.68	0.695
Phosphorus	0.007	0.005

"**Wheeling Steel & Iron Company.** This is another important steel and iron industry located at Benwood. This company operates 5 mills, three of which are located in Benwood; viz, the Benwood mill,, Benwood Steel Works and Benwood Pipe Mill. The Top & Belmont Mills are located in Wheeling. The daily capacity is 650 tons of steel billets, 300 tons wrought pipe, 500 tons steel skelp, 100 tons of iron skelp, 50 tons of steel and iron sheets and 600 kegs of cut nails. Their specialties are listed as wrought iron and steel pipe, special soft Bessemer, high carbon shovel steel, tack plate, steam, gas and water pipes are made in any sizes from 1/8 inch inside diameter to 12 inches."

McMechen.

McMechen, the third town of importance in Marshall county is located on the Ohio river, just across McMechen

run, south from Benwood. In 1900 it had a population of 1465.

[7]The town received its name from its first settler, William McMechen, who brought his family across the mountains from Allegany county, Maryland, in 1771, and settled and occupied a large tract of land fronting on the Ohio river, and extending from the mouth of Boggs run south to near the present town of Glendale.

At this time Indian raids were of almost daily occurrence. In 1777, on one of these raids, all but one of Mr. McMechen's horses were taken by the Indians. He pursued them as far as the Great Lakes, but without success. On his return he found that his wife had fled with the children and household effects to Red Stone Fort, Pennsylvania, for safety, and in doing so probably saved the family from extermination, since Foremans' defeat occurred shortly after. This defeat took place on the McMechen land and is marked by a monument with the following inscription:

"This humble stone is erected to the memory of Capt. Foreman and twenty-one of his men who were slain by a band of ruthless savages—the allies of a civilized nation of Europe —on the 25th day of September, 1777."

One of the series (No. 13) of locks and dams for the Ohio river, under construction by the U. S. Government, is located opposite the middle of McMechen (north and south) and is almost completed. This will furnish a fine harbor for Benwood, Bellaire and Wheeling.

Cameron.

Cameron, the fourth town in importance in Marshall county, is located along the main line of the B. & O. R. R., near the eastern edge of the county. In 1900 it had a population of 964, and at the present time the postmaster estimates it at 2100. The manufacturing industries are glass and pottery work.

7. Historical data kindly furnished by Mrs. A. C. McMechen, McMechen, W. Va., widow of Shepherd McMechen, a grandson of William McMechen.

The Glass Industry.

This industry is represented by the Patterson Window Glass Company. This company manufactures window glass and has been in operation for about 8 years. It employs about 75 men.

The Pottery Industry.

This industry is represented by the Eljer Company, established about 4 years ago. It has a four kiln pottery and manufactures table and toilet ware. The company employs about 150 people.

Bellton (Denver Station) and **Glen Easton,** next in order of importance, are located along the main line of the B. & O. R. R. Denver is situated 8 miles south, and Glen Easton, 4 miles west of Cameron, and each had a population in 1900 of 357 and 337 respectively.

All other towns in Marshall county not heretofore described have a population of less than 100, and are mostly cross-roads villages in rural districts.

WETZEL COUNTY.

Wetzel county is located south of and adjoining Marshall county, and has for its northern boundary line the extension to the Ohio river of the famous Mason and Dixon line; for its eastern boundary the dividing ridge between the waters of the Monongahela river and the Ohio; and for its western boundary the west shore line of the Ohio river at low water, or a frontage on the Ohio of 13 miles.

Its area, given by districts as computed by the U. S. Geological Survey from actual field work is as follows:

Districts	Sq. Miles
Grant	112.30
Proctor	55.40
Church	37.77
Clay	17.05
Green	60.15
Center	44.60
Magnolia	33.20
Total	360.47

In 1900 Wetzel county had a population of 22,880, of which 22,440 were white, 439 colored, and 393 foreign born. The mean magnetic declination was then 2 degrees and 30 minutes West.

The county has a range in elevation from 588 above tide at the Ohio river in the southwestern corner of the county to 1650 feet at the top of Honsocker knob in the northeast corner, or the top of another high knob, 0.8 of a mile southwest of Uniontown, or a range in elevation of 1060 feet.

Wetzel county began its existence by an act of the Virginia Legislature on January 10, 1846, and was cut off from the northern portion of Tyler county, retaining its original area to the present time. By the same act New Martinsville, previous to this time called Martinsville, was made the seat of justice.

Many evidences in the way of mounds similar in type to the one described above at Moundsville, though smaller, show that the same race of prehistoric people occupied the Ohio valley region in Wetzel county. Most expert archaeologists regard the Mound Builders as simply the predecessors of the Indians and hence of the same race.

Among the most important of these mounds is one near the fair grounds of New Martinsville. John C. McEldowney, Jr., refers to it in his History of Wetzel county as follows:

"The river bank below the fair grounds, opposite the amphitheatre, was possessed at one time of a mound that was very antique. The mound, which is now part of the Ohio

river, was at that time as high as the bank is today, it being very much isolated from the shore. It was often used as a place of resort for boys from the years 1840 to 1850. Samuel McEldowney at that time lived near the spot where the mound was situated. Many stone hatchets, tomahawks, spears, necklaces, earrings, arrowheads and many other curiosities were taken from the mound. But one of the things that was of so vast importance, and no doubt was greatly admired in prehistoric times, was a golden image of an unknown god, moulded out of fine gold, without a mixture of any other metalic elements. It was about 10 inches high, having a base as though it were an ornament, and moulded on it was a statue of an unknown god. It was found by the late Capt. Robert McEldowney. Willis De Haas, an antiquarian and agent for the Smithsonian Institution, was then writing a history of the border wars of West Virginia, and borrowed the curiosity. Comments of all kinds were passed upon it by all the leading newspapers of that day. The Secretary of the Smithsonian Institution authorized De Haas to purchase the image at any price if possible, but the prices offered were refused. The image was then borrowed by one Phenton McCabe who disappeared from the place as soon as he had the image in his possession. A half moon moulded of copper was found near the same mound and about the same time by Mrs. Geo. Martin." This "golden image" was most probably a "fake."

The writer also noted 2 such mounds on the Whittaker farm just north of the present mouth of Fish creek. These mounds occupy the ancient channel of this creek when it flowed north of the round isolated hill located at this point. The mounds were about 8 or 9 feet in height, having an almost circular base 30 to 40 feet in diameter. One of these had recently been dug into and the excavations revealed fragments of bone and mostly fine, brown sand. These mounds were evidently used as burial places for prominent chiefs or leaders.

Another mound was also noted in Cresap Bottom, nearly 2 miles north of Woodlands. This mound is on Quincy Cresap's land, just west and near the public road. It is 13 to 14

feet high, with a circular base. The top is slightly flattened and on the slopes are now found 4 locust trees and one large chestnut tree.

Other mounds and relics go to show this valley a favorite abode of these little known people.

Wetzel county is not so well adapted to agriculture as its neighboring county (Marshall) on the north. This is due to the more rugged topography, the hills being high, with steep slopes and narrow "V" shaped valleys. It has proved however to be the richest county in the state in the production of oil and gas, while the eastern two-thirds is underlaid by the great Pittsburg coal seam. The mineral wealth will be described in a later chapter.

The state auditor gives the following for Wetzel county for the year 1908:

	Assessed Valuation	State Tax
Real Estate.....	$10,591,074.00	$5,302.52
Personal Property	5,688,440.00	2,824.24
Total....	$16,279,514.00	$8,126.76

No state tax for school purposes. Each district makes its own assessment for maintenance of schools.

Wetzel county has about 30 towns scattered over its area, the most important of which are situated along the Ohio river valley and the railroads. Several of these towns have enjoyed a rapid growth in population during the last 10 to 15 years, due to development of the oil and gas industry. However, an oil town's rise is sometimes meteoric, and its decline often almost as rapid. A case in point is the town of Alvy, P. O. or Stringtown in eastern Tyler county. Ten to fifteen years ago in the palmy days of its oil development it had a transient population of 1500 to 2000, while at the present time it will hardly reach 400.

A brief account of Wetzel's most important towns will now be given.

New Martinsville.

The earliest settled town in the county was New Martinsville. Near the year 1780 one Edward Doolin patented and made entry upon 800 acres of Ohio river hill and bottom land which included within its boundary the present site of New Martinsville. The tract of land was situated in the angle formed by Fishing Creek and the Ohio river. Mr. Doolin cleared some land and built a small cabin near where now stands the Witten dwelling, selecting that spot on account of its nearness to a spring, it being the source of Little Doolin brook, which runs through the town.

In September, 1784 a small band of Indians came down the Ohio river from the village of Wheeling, where they had been driven off by Colonel Zane, attacked his home stealthily, and killed him. His wife and one child escaped. She retained ownership of the property for some time, selling it off in separate tracts. The portion on which the town is situated was purchased by Presley Martin, the man for whom New Martinsville was named. In 1811 Martin built a part of what is now the Point House and planted an orchard of five acres between Washington street and the creek. A few of these trees are yet standing.

From 1811 until 1838 the settlement grew slowly. On March 28th of the latter year, an act establishing the town of "Martinsville" in the county of Tyler was passed by the Assembly of the State of Virginia. The town extended from one lot below Washington street to North street, and from Union street to the river. In 1842 there were only 12 houses in the town. In 1846, when Wetzel county was formed from Tyler, the name of the town was changed from "Martinsville" to New Martinsville and the town made the county seat.

The low water level of the Ohio river at New Martinsville is about 590 feet above tide, and a large portion of it is built on the 625 to 630 foot level. Hence this part of the town is sometimes submerged 5 to 10 feet by the almost yearly spring floods of the Ohio, the most disastrous of which occurred in 1884.

In 1900 the population was 1089. However, during the last decade and since the completion of the Short Line railroad to Clarksburg, the town has had a rapid growth. The present population is estimated by the postmaster at 3250. The manufacture of glass is the most important industry.

The Glass Industry.

Magnolia Window Glass Company. This company was engaged exclusively in the manufacture of window glass prior to the great flood of March, 1907, when it was drowned out and has not since been in operation. Previous to that time it had operated about 2 years, and employed 150 to 200 people. It was a 24 blower tank factory.

New Martinsville Glass Manufacturing Co. This company is a flint glass concern, and was built in 1902. It burned down during the flood in March, 1907, but was immediately rebuilt and has been in constant operation except when shut down for repairs. It employs about 175 people—90 men, 60 boys and 25 women and girls.

The company manufactures a general line of table ware, lamps, tumblers, vases, bar goods and a few novelties, and also does some decorating in gold and in colors, both of the fired in decorations and the cold stain colors.

The average monthly pay roll is $8350.00, and the approximate daily capacity in finished wares is $750.00 for eleven months of the year.

Mr. John F. Martin, treasurer of the company, is authority for the above data.

Smithfield.

The town of Smithfield is located on the Short Line R. R., about 31 miles southeast of New Martinsville. The first settlement was made in 1796 by Aiden Bales. In 1900 it had a population of 333, but at the present time it is over 1000. Its rapid growth is due largely to its location at the western edge of one of the richest oil fields in the county.

Jacksonburg.

The town of Jacksonburg is also located on the Short Line Railroad, about 8 miles northwest of Smithfield. It was first setttled by James Hayes in the year 1805, who erected a cabin on the ground now owned by his grandson, G. W. T. Anderson. It was formerly called Lot, and, after the construction of the Short Line railroad, was changed to Jacksonburg. In 1900 it had a population of 340, but since that time has had a rapid growth due to the oil and gas development and has become one of the best towns along this branch of the Baltimore & Ohio R. R.

Pine Grove.

About 4 miles northwest of Jacksonburg, on the Short Line R. R. is located the town of Pine Grove. The first settlement was made here by Morgan Morgan about 1804. The town took its name from a beautiful grove that once stood near the place. In 1900 it had a population of 112, but has probably 3 or 4 times that number of inhabitants now. Its growth has been due to the same causes as given for Smithfield and Jacksonburg. viz, the development of the nearby oil and gas fields.

Hastings.

About a mile above Pine Grove on the Short Line R. R. is the town of Hastings. This is a new town built since the completion of the railroad. The largest natural gas pumping station in the world is located here. This station is the property of the Hope Natural Gas Company, a subsidiary branch of the Standard Oil Co. The present power equipment consists of 2 monster gas engines of 4,500 horse power each, and 10 steam engines of 1,000 horse power each, or a total of 19,000 horse power.

Hundred.

Hundred is located on the main line of the B. & O. R. R. in the northeast corner of the county. The first settlement was made by Henry Church in 1819. He was a British soldier and served under Cornwallis during the Revolution. He lived to be 109 years old and his wife 107 and on account of his great age he was called "Old Hundred," and from him the town took its name.

In 1900 the town had a population of 261, but during the last decade it has enjoyed a very rapid growth and has over 1000 inhabitants now.

The town is situated on the crest of an anticlinal arch and as a consequence is the center of a great gas field. Three large natural gas pumping stations are located at or close the town and furnish employment for a number of its citizens. The first of these, the Philadelphia Company's plant is located at the northeast edge of the corporation; the second, the Wheeling Natural Gas Company's plant, at the southeast edge; and the third, the Carnegie Natural Gas Company's plant, a short distance below town, at the mouth of Rockcamp run.

Burton.

Burton is also located on main line of the B. & O. R. R., 2 miles southeast of Hundred. It was settled in 1812, seven years before Hundred, by George Bartrug. In 1900 it had a population of 158, but now probably has 250 inhabitants. It has recently passed through a period of increased business activity on account of the development of the Maxton Oil Sand pool to the east and northeast.

Littleton.

The town of Littleton is also situated on the main line of the B. & O. R. R., in the northeast corner of Wetzel county, close the southwest corner of the State of Pennsylvania. In 1900 it had a population of 509. In February, 1906, the town had a very disastrous fire that almost swept it completely out

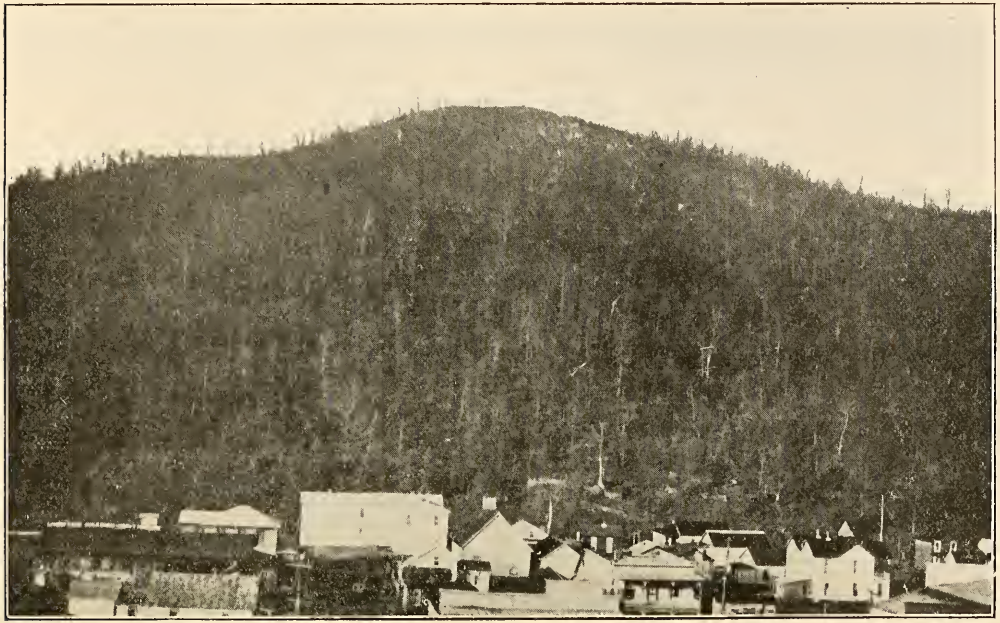

Plate II.—Owlshead Knob at Jacksonburg, Wetzel County.

The glass industry is also represented here on a small scale.

Duquesne Glass Works. This plant is engaged in the manufacture of bottles mostly for beer. When running full it employs about 50 people. At the present time it is running only about one-fourth capacity.

Ohio Valley Glass Company. This company is engaged in the manufacture of cathedral glass and runs the year round. It employs 12 to 15 people.

Steelton.

Steelton, situated 3 miles north of New Martinsville, on an old river terrace similar to that at Paden City, is another example of a "steel mill boom town" failing to materialize.

The **Wheeling Roofing & Cornice Company,** built a small plant here, supposedly to manufacture roofing and cornice work, but nothing in the manufacturing line has yet been accomplished.

Other Towns.

Other towns of Wetzel county are Proctor, located 6 miles north of New Martinsville; Robinson and Folsom, in the southeastern corner of the county on the Short Line R. R., Porters Falls, 12 miles southeast of New Martinsville on the same railroad; and the following towns in the interior away from any railroad: Endicott, Uniontown, Jolliffe, Earnshaw, Dean, Kodol, Silver Hill, West, Marion, Andy, Piney and Arches.

Much of interest might be written about all of these towns but space will not permit in a report of this nature.

TYLER COUNTY.

Tyler county was formed from Ohio county by an Act of the Virginia Assembly, December 16, 1814, in which it was given the following boundaries:

Beginning at the southwest corner of the State of Pennsylvania; thence a due west line to the Ohio river; thence with said river to the Wood county line; thence with said line to

the line dividing Monongalia from Ohio county; thence with said line to the Pennsylvania line, and with it to the beginning.

The present area of Tyler, 260 square miles, shows a great reduction from the boundary called for above. Its area given by districts as computed from the accurate topographic maps of the U. S. Geological Survey is as follows:

Districts	Sq. Miles
Lincoln	31.46
Union	30.78
Ellsworth	69.50
McElroy	54.63
Centerville	38.02
Meade	35.73
Total	260.12 Sq. Miles

It received its name from John Tyler, former Governor of Virginia and father of John Tyler, tenth President of the United States.

[8]In 1900 the county had a population of 18,252 of which 18,153 were white, 94 colored, and 295 were foreign born.

The mean magnetic declination in 1900 was 2 degrees, 30 minutes West.

The county has a range of elevation from 580 feet above tide, low water level of the Ohio river near Bens Run, to 1500 feet above tide at the top of a high knob, on the Wetzel-Tyler line, 2 miles northeast of Alvy (Stringtown), in the extreme eastern portion of the county, or a total range of 920 feet. Many residents of Tyler think a high knob, called "Owlshead," 2 miles northeast of the town of Wick, the highest in the county, but it lacks 75 to 80' of being as high as the knob referred to above, since the top of it is only about 1415 above tide.

Tyler has a much smoother topography than Wetzel and is therefore better adapted to farming than the latter. The soil has become exhausted somewhat and the farms have been neglected over a great portion of the county since the development of the oil and gas industry 15 to 20 years ago. It ranks next to Wetzel county in oil production.

8. Bulletin No. 233, U. S. Geol. Survey.

The State Auditor gives the following valuation of property for Tyler county for the year 1908:

	Assessed Valuation.	State Tax.
Real Estate.....	$6,048,499.00	$3,024.23
Personal Prop'ty..	5,828,095.00	2,917.70
Total.....	$11,876,594.00	$5,941,93

There is no state tax assessed for school purposes. Each district makes its own assessment for maintenance of schools, both for teachers' and building fund.

The towns of Tyler county are as follows: Sistersville, Middlebourne, Alvy, Friendly, Bens Run, Alma (Centerville), Shirley, Wilbur, Pursley, Kidwell, Deep Valley, Josephs Mills, Bearsville, Wick, Meadville, Shiloh,, Little, Long Reach, Big Moses, Braden Station and Conaway.

With the exception of the first 4 or 5, the towns are small and mostly post villages for rural districts. Some have had a "mushroom" growth and a sudden decline caused by rise and fall of oil and gas development. The village of Elk Fork, 2 miles east of Kidwell, in the latter 90's had a population of 300, while at present there is no town there.

A brief description of the most important Tyler county towns will now be given.

Sistersville.

Sistersville is located on the Ohio River Railroad along a high terrace of the Ohio river, about 10 miles below New Martinsville, and midway between the cities of Parkersburg and Wheeling. The first settlement was made in 1802 by Charles Wells who emigrated there with a part of his family, consisting of 22 children, from Wellsville, Ohio. He settled just below where the town now stands, built a log cabin, and set up the first horse-power mill in this vicinity, which ground grain for the early settlers. All the high bottom land upon which the town now stands was owned by Charles Wells. Soon others came and it was not long before the village began to show evidences of growth and the Wells' farm converted into a town.

though it was not laid out in lots until after the owner, Chas. Wells' decease, when the land fell into the hands of Sarah and Delilah Wells, sisters, after whom the town was named, "Sistersville."

The ground was plotted in 1815 and originally contained 96 lots on four streets running back from the river: viz, Catharine, Charles, Diamond and Elizabeth streets, and four streets running parallel with the river; viz, Water, Main, Wells and Brown Betty. The town was originally intended for the county seat, and at the crossing of Main and Diamond streets, a diamond shaped spot was laid out, around which were to cluster the courthouse, jail, whipping post and lawyers' offices. The first court was held at the house of Chas. Wells on July 9, 1815. Contracts were at least partly negotiated for the building of a jail and courthouse, but before 1816 had passed Middlebourne had become the county seat. In 1840 the town contained 10 or 12 houses. The town didn't grow much however until the boom of 1892, caused by the great oil strike in the Polecat run well by Ludwig and Mooney. It was then like the opening of the Klondike gold regions, for scarcely had the report been circulated when people began flocking to the town. It enjoyed a very rapid growth up to 1900 when it had a population of 2979, and at the present time the postmaster estimates it at 3500. It is one of the best paved towns in the state, and has been the chief distributing point for oil well supplies for the various fields over the county. The Carter Oil Company, a branch of the Standard Oil Company of New Jersey, has its repair shops and offices here and furnishes employment for a large number of men. Several other oil producing companies have their offices located here.

The Sistersville Boiler Works, owned by E. A. Ryan, are located here. They employ about 50 skilled workmen, and repair boilers, as well as manufacture steam boilers for the oil fields, also iron tanks which are largely replacing the wooden oil tanks at oil wells.

The Wells Glass Co., owns two window glass factories in Sistersville. The first of these plants was built by the Sistersville Window Glass Co., in 1901. It has a 24 blower tank and is now under lease to the Independent Glass Co., and when

running full, employs about 120 people. The second of these plants was built by the Tyler Window Glass Co., in September, 1902, and was only a 12 pot factory. It was purchased by the Wells Window Glass Co., in 1906 and has not been in operation since that time.

Middlebourne.

Middlebourne, located on the north bank of Middle Island creek, 7 miles southeast of Sistersville, was first established January 27, 1813, as a town, by legislative enactment, on the lands of Robert Gorrell, then in Ohio county. As before said the first county seat of Tyler county was Sistersville, but was changed to Middlebourne in 1816. The town was incorporated February 3, 1871. It is built on an old terrace of Middle Island creek. In 1900 it had a population of 403. Its present population is estimated by the postmaster at 900.

The **Tyler Brick and Tile Co.,** opened up a brick plant in July, 1907. It manufactures brick for building purposes, and for sidewalk paving for local domestic trade. For more particulars concerning this, see Chapter on Clays.

Friendly.

The village of Friendly is located 5 miles southwest of Sistersville on the Ohio River R. R. branch of the B. & O. It was named in honor of Friend Williamson, a resident of the place before it was plotted into town lots. The site covers about 27 acres and was originally a part of the farm of A. R. Williamson, who laid it out in lots in 1884. It is situated on high ground and is one of the prettiest places along the Ohio river. It is surrounded by an oil field and a rich agricultural region. In 1900 the population was 253.

Alvy (Stringtown).

The town of Alvy, most generally known as Stringtown, is located in the extreme eastern point of Tyler county on the head of Indian creek. It is located in the heart of the greatest

oil field in the state. This field is 3 to 5 miles wide and 17 miles long. When this field was opened up on Indian creek in 1896, the town had a very rapid "mushroom" growth and its population soon attained to over 2000, but it fell off just as rapidly and in 1900 was only 433. At the present time it is probably less than 400.

Alma (Centerville).

Centerville, or Alma P. O., is located 6.3 miles southeast of Middlebourne. In 1900 it had a population of 267. It is surrounded by a rich agricultural region, where the hills are low and rounded and adapted to tillage.

All other towns in Tyler county are small, cross road villages, generally distributing points for mail and supplies for the surrounding farmers.

CHAPTER II.

THE PHYSIOGRAPHY OF THE MARSHALL-WETZEL-TYLER AREA.

To the old resident of the Marshall-Wetzel-Tyler area the general surface configuration, represented by the valleys and hills, never changes, but to the contrary seems everlasting. However such is not the case. In fact the hills and valleys, that seem to have stood unalterable through the ages, pass through a cycle of life, **youth, maturity** and **old age,**—similar to the life history of organism such as man.

Everything changes and grows old, and all must conform to the universal laws of nature—adjustment to environment and surrounding conditions. This applies to the inorganic world of rocks, hills and mountains as well as to the world of living organisms. Even now these changes are taking place rapidly, when duration of time is considered in a geologic sense, though such changes might not be visible to the untrained eye.

The atmosphere with its evaporation and precipitation, its electrical effects, its variations in temperature, heat and cold; running water, both surface and underground, all combine to form the engraving tools that disintegrate the rock material and start it on its ceaseless march to the sea its final resting place.

More clearly to understand how these forces of air and water do their work we will let one's imagination picture the formation of some typical land area. For instance we might consider the sediments that have accumulated off the mouth of some great river, assuming that they become so cemented together as to form rock material and in this hypothetical case

that some earth movement has caused the emergence of these sediments above the level of the sea at a considerable elevation to form an island. Now from the very nature of the source of these sediments composing our imaginary island, it is very evident that the material cannot be absolutely homogeneous, and that its surface configuration will not be exactly dome shaped and without depressions. The action of shore currents and other agencies would prevent that. The top surface might be a smooth upland plain or plateau. The rain descending on this land would gather in the depressions and start as many streams or rivulets. These in turn may flow together and form larger streams. As these larger streams increase the size of their basins, their volume would increase in turn, and soon become rivers. On the same slope the streams follow nearly parallel courses that are separated by low divides. The channels are soon carved deeper by the erosive action of the silt laden waters. The little tributaries are enlarged and these in turn divide forming smaller tributaries, all continuously cutting backward into their divides until the entire land area is covered by a network of streams resembling the vein work of a maple leaf, or the trunk, branches and twigs of the tree itself. At the same time atmospheric agencies such as wind, heat, cold, rain and possibly ice and snow forming their resulting glacier, may all be at work widening the upper portion of the valley of the stream so that it loses its trench-like character. Since the material is not homogeneous, the streams in their courses often encounter hard rock material that deflect them to one side and around the obstruction. Hence it follows that the seaward course of a stream is not straight and narrow but meandering in its nature.

The erosive work on our imaginary island never ceases, but goes on century upon century, until streams on the opposite sides of the divide approach each other finally cutting the divide away into a series of hills which in turn are attacked by the never-ending energy of air and water until they too disappear wholly or in part. There now remains a smooth plain near the level of the sea, with a gradient so low that

water erosion ceases and our land is then said to be at **base-level**. Our island has now passed through a complete cycle of history,—from sea plain through upland plain to coastal plain. This plain is not just like the original sea plain for scattered over it will be seen a few low rounded hills called **monadnocks** but it is almost a plain and so it has been called a **peneplain** (pene—almost) .

The name "Monadnock" was given to these rounded hills by W. M. Davis from Mount Monadnock, in southern New Hampshire, which is an example of a remnant, and forms a prominent feature on the surface of an elevated peneplain. Hence a "monadnock," then, is a hill or mountain left standing on a peneplain, owing to incomplete planation.

Earth forces may again elevate our island peneplain and start over again a second time the work of erosion along the same line of development. The studies of geologists reveal the apparent fact that the Appalachian area was reduced to a peneplain in Cretaceous time, and re-elevated to be reduced to a second peneplain during the Tertiary period. Again to be re-elevated at the close of the Tertiary period, and at the present time being reduced to a third peneplain.

The rivers and large streams pass through the same cycle of development as the land forms, and may be compared in the same way to the life history of organisms, passing from the period of infancy or youth, through adolescence, maturity, to old age and death.

The erosive life of a river is not measured so much from the duration of its existence as by the work of erosion that it has accomplished and what yet remains to be completed.

In the early stage of the stream's formation the longitudinal slope of its channel, as it cuts its way downward, is steep. Erosion is necessarily rapid through the softer rocks, the harder and more resistant layers forming water falls and the stream now in its period of infancy or youth is passing to **adolescence**.. It is now cutting its channel deeper and deeper and does very little lateral erosion. As the channel floor of the stream approaches closer the level of its mouth, the gradient is much reduced and as a consequence the current of

the stream much slower, and the hard projecting ledges are brought to the general slope of the stream. Its load of sediment formerly carried outward by the swifter stream is deposited in flood-plains, the river now taking up the work of lateral erosion except in case of floods and over these flood-plains takes a meandering course, cutting in on one bank and depositing on the other. It is now carrying its maximum load of sediment and is performing its greatest work of erosion and is said to be in the **maturity** of its life.

The period of old age is said to be reached by the river when it has graded its valley floor to sea level. The current then becomes sluggish and absent, the falling sediment obstructing the channel, and the river is not able to perform the work of erosion any longer, settling down to a period of senility.

All the periods of a river's life may be represented at the same time. The lower course reaches old age first while the upper course is pushing its way back into the divide in early maturity, while some of its tributaries are in the period of youth. Sometimes on the steeper slope of a divide the swifter and more rapid stream cuts through the divide, taps the head waters and robs a stream on the opposite side. This is called **stream-piracy.** The remnants of the old stream, still pursuing their old courses, are spoken of as beheaded streams. A case in point is Beaver Dam creek where it formerly crossed Blue Ridge, 6 miles due south of Charlestown, W. Va. [1]This stream was unable to deepen its channel across this hard rock ridge as rapidly as the Shenandoah branch of the Potomac lowered its bed, and as a result the first stream was beheaded by the Shenandoah river. This is only one of numerous instances of this kind.

It sometimes happens that a stream in mature age is revivified with all the appearances of youth. For instance take a peneplain that has been elevated to an upland, having its mature, meandering rivers. It naturally follows that the work of erosion is taken up first along these old channels. These rivers then take on the activity of renewed youth and

1. Professional Paper No. 60, p. 51, U. S. Geol. Survey.

cut their inherited gorges with their winding courses deeper. Thus we have a youthful stream with many features of inherited maturity.

Sometimes the course of a river and topographic history may be influenced by forces so unusual as to be termed a "geologic accident." Such was the case during the Quaternary period of the history of the North American continent, when the northern seas were covered with an ice sheet of great extent and thickness. This great wall of ice moved southward, forming dams across the courses of rivers resulting in great ponds and lakes, causing them to overflow at some low point in their enclosing valley walls. Here further erosion would take place, and form a new channel which might be continued when the ice-barrier melted away.

The southern terminus of this great northern glacier was 45 to 50 miles north of the Marshall-Wetzel-Tyler area, but the indirect effects of flood and water extended far to the south of this area.

If we make an examination of these three counties with reference to their drainage system, we find the larger streams in the whole area have a distinct northwest trend and at the same time a meandering channel. Now in order to understand better the river history of this area it is best to pass back in time to the period before the glacial invasion, and attempt to construct from topographic evidence the pre-glacial drainage. Concerning this Prof. Grimsley, Assistant State Geologist, has the following to say in his Panhandle report, pages 22 and 23.

"America's best glacial geologists have studied this problem and from their investigations have delineated the courses of the rivers of that far away time. It is thus found that the drainage conditions were very different. There was no Ohio river flowing south-westward to join the 'Father of Waters,' though rivers occupied a portion of the valley now drained by the Ohio. Near Moundsville, Leverett found the evidence of a former divide, the waters flowing south from there to about the location of Point Pleasant, then turning north-westward across Ohio in what Professor Tight has named the

Marietta river. From the Moundsville divide there flowed northward the old Ohio to near the mouth of the Beaver, where it emptied into a river flowing north to the site of Lake Erie, a river which has been named the Pittsburg.

"The tributary streams across the Pan Handle had a similar north direction, flowing northwest to join the old Ohio. The terraces of this old river are still visible especially in the northern part of the Pan Handle and adjacent portions of Ohio and Pennsylvania.

"When the great ice wall crossed the path of the Pittsburg and other northward flowing streams, their waters were held back before the ice obstruction, filling their valleys which stood at much higher level than at present. The waters spread outward on their higher slopes forming some of the higher river terraces. The rivers finally cut their way through low portions of the divide taking a southern course. The Ohio cut through the divide near Moundsville, joining the Marietta river, whose northern outlet was also cut off, and the present Ohio river came into existence cutting through the divide farther south, probably following closely its present path. The Monongahela tributary to the Pittsburg river may have cut through near Salem and passed south-eastward for a short time. When the ice sheet finally retreated, the Monongahela regained its former course, but the Ohio remained in its new channel.

"In this early history of the Ohio river the water flowed at a much higher level than now. The present channel has been largely cut down since the Glacial period. The old terraces left here and there along its banks mark the elevation of the channel in its different stages. These terraces reach 1000 and 1050 feet above the sea near Wheeling, while the present river is about 610 feet above the mean tide. At the mouth of the little Beaver river, opposite the northern edge of the Pan Handle, the terraces are 870 to 965 feet. According to Leverett, the river cut down to the 930 foot level near Wellsburg before the course was reversed to the south. The channel has been cut from 930 feet to 660 feet since the Glacial period. There is also evidence that it cut deeper for the rock floor is

about 30 feet below the present river floor, and has been filled with sediments. There still remain in this area as monuments of this ice invasion, the gravel and boulder terraces."

With the exception of the lower course of Middle Island creek all the large streams of the Marshall-Wetzel-Tyler area have preserved their original northwest trend, and all are enclosed in high valley walls, with meandering course, tending to show that they possess their mature character by inheritance, since all have a rapid fall to the Ohio river. For this reason the writer is inclined to the belief that the old divide between the Marietta river and the old Ohio, referred to by Leverett above, instead of being at the "narrows" north of Moundsville, was more probably located about two miles below New Martinsville. The northeast direction of the larger streams on the Ohio side as well as the northwest direction of the same on the West Virginia side would seem to indicate this divide as located about 30 miles farther down the valley of the present river than the location given by Leverett.

It is of interest to call especial attention to the head waters of Pt. Pleasant creek, a stream whose source is against the same dividing ridge (according to the writer) as the old Marietta river. One of the low gaps between this stream and the Ohio river, located about 2 miles below the mouth of Fish creek, has an elevation of only 910 feet above tide, while the river at low water at this point is 590, or a difference in elevation of 320 feet. This low gap is within one-half mile of the location of the theoretical low gap heretofore designated by the writer as instrumental in joining the headwaters of the old Ohio and Marietta rivers. According to Leverett the Ohio river has cut down its channel at Wellsburg, W. Va., from the 930 A. T. level to its present level 660 A. T. since the glacial period. When at that former high level it does not require a very wide stretch of the imagination to picture the back water of the old Ohio, due to the advancing glacier from the north, seeking this low gap at the head of the old Marietta and discharging its surplus waters southwest along the latter stream. It is also quite likely that some of this surplus water was discharged for a time through the other low gap via

Point Pleasant and Middle Island creeks, and that the final location of the Ohio river hung in a balance as it were. In fact the unusually wide bottoms and low rate of fall at the head of Point Pleasant creek, an advanced stage of erosion not characteristic of other streams of equal length in the Marshall-Wetzel-Tyler area, would seem to indicate that the surface drainage was greatly assisted in the work of erosion at some period in this stream's life.

At Kidwell, opposite the mouth of Elk Fork is a rounded and almost isolated hill the summit of which is 900 A. T. Its shape is entirely due to the erosive action of running water. It is not at all unlikely that this odd topographic feature may owe its present configuration to the increased discharge of glacial water through the low gap at the head of Point Pleasant creek.

None of the streams in the area under discussion is at base level, but all descend rapidly to the Ohio. Taking up the streams successively from north to the south, Wheeling creek has a fall of 8 feet to the mile in the last 12 miles of its lower course from the mouth of Grandstaff run. The air line distance is only 6 miles. Grave creek has a fall of 23.4 feet to the mile in the last 19 miles of its course from Cameron to Moundsville, or a total fall of 445 feet. The air line distance is about 12 miles. Fish creek has a fall of 6.7 feet to the mile in the last 26 miles of its course, from Kausooth to Woodlands, or a total fall of 175 feet. The air line distance is about 11 miles. Proctor creek has a fall of 54.8 feet to the mile in the last 5.2 miles of its course, from Marion to Proctor Station, or a total fall of 285 feet. The air line distance is 4 miles. Fishing creek has a fall of 4.4 feet to the mile in the last 22½ miles of its course from Pine Grove to New Martinsville, or a total fall of 100 feet. The air line distance is 11.5 miles. Middle Island creek, the last large stream of importance, has a fall of one foot and a half to the mile in the last 39 miles of its course, from Middlebourne to the Ohio river, or a total fall of 60 feet. The air line distance is about 17 miles. The following table will show this up in more graphic form:

Creek From Mouth to Point on Same.	Total fall. Feet.	Rate of fall per mile. Feet.	Total distance Miles.	Air line distance Miles.	Ratio T. D. to A. L. D.
Wheeling, to mouth of Grandtsaff run	96.0	8.0	12.0	5.0	2.40
Grave, to Cameron	445.0	23.4	19.0	12.0	1.60
Fish, to Kausooth	175 0	6.7	26.0	11.0	2.30
Proctor, to Marion	285.0	54.8	5.2	4.0	1.30
Fishing, to Pine Grove	100.0	4.4	22 5	11.5	1.95
Middle Island to Middlebourne.	60.0	1.5	39.0	17.0	2.30

The last column shows the ratio of the total distance (T. D.) to the air line distance (A. L. D.) The greater the rate of fall, the nearer this ratio approaches unity or 1.0, which is as it should be.

Previous to the glacial period these streams probably cut their channels to near the base level of the northward flowing Ohio, and then started to cut their present meandering channels. Later the greatly increased volume of water in the Ohio now flowing southwestward, cut its channel deeper much more rapidly than its tributaries, hence the latter were revivified, and endowed with new life and energy.

DESCRIPTION OF THE DRAINAGE BASINS.

Wheeling Creek.

Prof. Grimsley has the following to say about Wheeling creek in his Panhandle (W. Va.) report:

"Wheeling creek rises in the western part of Greene county, Pennsylvania, and flows northwestward through the northeastern part of Marshall county and the southwestern part of Ohio county, emptying into the Ohio river at Wheeling. Its channel is very crooked, winding back and forth and making a complete bend on itself at the east side of the city of Wheeling.

"At Elm Grove, in Ohio county, it receives the largest tributary stream, Middle Wheeling creek, which is joined by Little Wheeling creek one mile and a half east, near Triadelphia. Little Wheeling creek rises near West Alexander, just

over the state line in Pennsylvania, and flows southeast to Elm Grove. Middle Wheeling creek rises in the western part of Washington county, and flows almost east in a winding channel.

"The drainage basin of Wheeling creek and its tributaries, in western Washington, eastern Ohio and Marshall counties, covers 192 square miles, being nearly as large as the total drainage areas of all the other creeks of the district described.

"Near the mouth of Wheeling creek there is evidence of readjustment of the course of the stream in the big bend around the Wheeling peninsula. Just north of the city on the reservoir hill there is a break in the hill, through which the creek probably flowed at this high level when the Ohio had its northern course. As the Ohio cut its channel down and flowed to the south, the creek was unable to continue in its old path and turned to the south, following around Wheeling hill to join the river below.

"Farther back near Mont de Chantal, the creek has apparently followed three different paths in its downward cutting, one to the north, one to the south, finally selecting the middle course. The difference in level of these three paths is only 40 feet, and at high water the stream might take any one of these three channels.

"The tributary streams from the north into Wheeling, Middle, and Little Wheeling creeks follow nearly parallel courses to the south. The divide between Wheeling and Buffalo creeks is a winding ridge trending approximately east and west and located near the northern part of Ohio county. Nearly the entire county of Ohio is thus drained by Wheeling creek and its tributaries, with the exception of the northwestern part drained by Short creek, and the northeastern corner drained into Buffalo creek.

"The most important tributaries of the Wheeling creek system from the north are, Peters, Roney's Point, Dixon, Battle, and McGraw runs, while from the south, Point run passes into Little Wheeling. Flowing into Middle Wheeling creek from the north are, Marlow, Orr's, Hall, Coulter, and Todds runs; while from the south are Gillespie and Ladley runs.

Wheeling creek receives also from the north Woods run, formed by the union of Long and Waddle's runs, and Carter run. The tributary streams from the south into Wheeling creek and its two main branches, travel for the most part short paths with rapid descent down the steep south banks, and the water falls from ledge to ledge of the hard resistant layers."

In Marshall county the most important branches of Wheeling creek from the north are Barnett, Grandstaff, Turkey, and Worton runs, and from the south are Jake, Burcher, Stull, Wolf and Dunkard runs. The area of its drainage basin within the Marshall county boundary is 71 square miles.

Grave Creek.

Grave creek has its source in the western edge of Greene county, Pennsylvania, and flows northwest across the middle portion of Marshall county emptying into the Ohio river at Moundsville. It has a rapid fall, its rate being nearly 3 times that for Wheeling creek, hence it does not have so many great loops and bends as the latter.

When Moundsville is reached, Grave creek takes a sudden bend to the southwest to join the Ohio. At one time it probably continued straight on in its northwest course across the present site of Moundsville to join the old Ohio. Middle Grave creek joins the stream south of the town, and these 2 streams in conjunction with the river have cut out a wide bottom here, giving an ideal location for a town.

The other important tributaries of Grave creek from the north are Burch, Straight and North Fork runs. The tributaries are all short and unimportant from the south side. The area of its drainage basin is 76.7 square miles.

Fish Creek.

This creek has its source in the northeast corner of Wetzel county and flows northwest entirely across the southern portion of Marshall county and empties into the Ohio river at Woodlands, 12 miles below Moundsville. It has a much

larger drainage basin than Grave creek. Its rate of fall for the last 26 miles of its course is still less than for Wheeling creek. The meanders of the creek are sharp and long, being sometimes almost two miles from the direct course. But the high rock valley walls tend to show that the streams have inherited this mature character, and that at one time this stream was near base level, and afterwards revivified. At 2 or 3 points along this stream there seem to be old abandoned channels. An examination of the topographic map in the vicinity of Adaline will reveal some interesting stream piracy. It would appear that here the waters of Maggoty run and Fish creek at one time both flowed in the channel south of the hill just north of Adaline P. O. as located on the topographic sheet, and that the last ¾ths mile of Valley run occupies an old abandoned channel of Fish creek. About one half mile above the mouth of Upper Bowman there appears to be another cut off and an old loop to the north abandoned. Several old terrace deposits were noticed along this valley.

The principal tributaries from the north side are Little Tribble, Big Tribble, Lower Bowman, Middle Bowman, Upper Bowman, Maggoty, Big, Cedar, Harts, Penna. Fork, Wolf, Browns, Rock Camp and Church Fork runs, nearly all of which are rudely parallel in a northeast-southwest course. They all have sharp "V" shaped valleys with high steep valley walls and narrow, hogback ridges between.

On the south side of Fish creek, its tributaries are not nearly so uniform in direction. Their names are Long, Whetstone, Lynn Camp, Valley, Laurel, Rocky, Knob Fork, Sugar, Long Drain and Rush runs.

At the mouth and on the north side of Fish creek is located a rounded, isolated hill, reaching an elevation of 860 feet above tide, the river being here about 590. On the north side of this hill can readily be seen the old channel of Fish creek, about 690 A. T. The channel evidently changed to the southern side of this hill after the glacial period, when the old Ohio started flowing southwest.

Remnants of old terraces are found almost to the head of Fish creek, possibly corresponding closely to the old ter-

races on the Ohio river, and they no doubt owe their presence to the same natural causes. The area of its drainage basin within the Marshall-Wetzel-Tyler boundary is 214.3 square miles.

Proctor Creek.

Proctor creek carries off the surface waters of the northwestern part of Wetzel county. Its drainage basin is small compared to Fish creek, being only 8 to 10 miles in length. It empties into the Ohio river at the town of Proctor. The stream is still in the period of youth since in the last 5 miles of its course it has a fall of almost 55 feet to the mile. It has a very marked "V" shaped valley whose enclosing walls are high and steep sloped. The principal tributaries are Left Fork, McCloud, Mudd, and Furbee runs. The area of its drainage basin is 22 square miles.

Fishing Creek.

Fishing creek has its head in the extreme southwest corner of Wetzel and carries off the surface waters of the southern portion of the county. Its entire drainage basin lies within the boundaries of this county and has an area of 220 square miles.

From Pine Grove to its mouth at New Martinsville the fall is slightly less than 4½ feet to the mile, or only about ⅔rds that for Fish creek. Like Fish creek, it possesses the features of inherited maturity along with those of early youth. Its channel often deflects over a mile from its general northwest direction, and in places has taken the near cut across these bends, leaving the abandoned channels as evidence of their former existence.

About ¾ of a mile above Jacksonburg occurs a freak in stream topography. Here the stream makes a bend of one-half mile to the north directly opposite its old abandoned channel where it formerly made an equal deflection to the south. The present stream level at this point is about 745

above tide, while the high point in the abandoned loop is about 810 A. T. The Short Line R. R. here follows still another old channel of this stream about midway between the extreme points of the loops.

Opposite the mouth of Crows run, just above the town of Reader appears to be another old abandoned loop of Fishing creek.

On the North Fork of this stream, one mile and a half above Pine Grove, occurs a long bend to the southeast. Here it is evident that the time, geologically considered, is not far distant when the stream will take the short cut across the neck of the jug-like bend. Or it may have flowed across this neck in former times, since the low point of the neck is only about 10 feet higher than present stream level on the northeast side.

The topography of the area drained by Fishing creek, or for that matter of the entire Marshall-Wetzel-Tyler area, is in what is known as the mature stage, that is, the valleys are all developed to such an extent that the surface is practically all reduced to slope. In other words, little can be seen of the original pleateau in which the valleys have been cut, although small remnants of it appear at various points at elevations of 1400 to 1650 feet above sea level. There is no considerable area where the 20 foot contour lines are not crowded, with the exception of a narrow flat, varying from a few feet to one-half of a mile in width, along the Ohio river front.

The general direction of Fishing creek is about North 60° West and topographic evidence would seem to indicate that it belonged to the pre-glacial Ohio drainage flowing northward, and not to that of the old Marietta. The dividing ridge forming the boundary line between Wetzel and Tyler counties must have held the low gap that was instrumental in joining these two ancient rivers to form the present Ohio.

Two large tributaries; viz, Little Fishing and North Fork, put in from the north side. Other branches of less importance flowing in from this side are Turkey, Money, Reader, Shenango, Lower, Upper, Richwood, Fallen Timber, and Price runs. Among those putting in from the south side are Flu-

harty, State, Brush, Crow, Piney Fork, Buffalo and Arches Fork runs.

Remnants of old terraces are found all along Fishing creek the same as on Fish creek to the north.

Middle Island Creek.

Middle Island creek is said to be the longest stream not to bear the name river in the United States. The air line distance from its mouth at the Ohio river to its head in southeastern Doddridge county is slightly over 38 miles. The same distance measured along the meanders of the stream is over 100 miles. The crookedest portion of the creek lies within Tyler county. The air line distance between the point where the creek enters Tyler county (63 miles above its mouth) and where it leaves the same (17 miles above its mouth) is 12.8 miles. This same distance measured along the stream is 46 miles, or the ratio of total distance to air line distance is about 3.6.

The entire area of Tyler county with the exception of a narrow belt along the river front, lies within the drainage basin of Middle Island Creek. The area of its drainage basin within the limits of Tyler county is 246 square miles.

From Middlebourne to the Ohio river, a distance of 39 miles, the total fall is only 60 feet or an average of about 1 foot and a half to the mile. This would indicate that the lower course of the stream is fast approaching to a base level with the Ohio.

Like Fishing creek its channel possesses many features of inherited maturity along with those of early youth. The stream in some instances meanders over 2 miles from its general course which is northwest until the latitude of Middlebourne is reached when it changes to southwest. This would seem to indicate that it flowed into the pre-glacial Marietta river. The famous "jug" of Middle Island creek is located about 2 miles above Middlebourne. Here the creek made a great bend or loop to the south 3.5 miles around same and came back within 50 feet of itself. Within recent years an at-

tempt has been made to utilize the difference in level, about 10 feet between the two portions of the stream for water power by digging a cut across the low, narrow neck of the peninsula. Floods of course have greatly enlarged this cut and at the present time, when the water is low, the entire discharge flows through the new channel. The peninsula is now an island, and not many years in the future very little of the stream's output, even in time of floods will go around this bend.

At two other prominent points in Tyler county, Middle Island has made similar cut-offs, as evidence by the old, well marked channels at slightly higher elevation than the present stream level at the points in question. The first of these abandoned loops is located about one-half mile above Josephs Mills, and at the present time Little Camp Mistake run follows the old north channel of the last 0.8 of a mile of its course. The highest point of this old channel is barely 30 feet above the present level of the stream at the neck of the cut-off.

The other abandoned loop which is also easily observed on the ground is found at the point where Middle Island crosses the Tyler-Pleasants boundary line. At this point the creek at one time made a great bend of almost a mile to the south. The old channel is plainly visible, the elevation of the highest point of which is about 690′ above tide. The present level of the creek at the neck of the cut-off is about 610′ A. T.

Many old terraces are found along the enclosing valley and its tributaries. These terraces no doubt owe their origin to the same causes as for those on Fish, and Fishing creeks and on the Ohio river.

The tributaries of Middle Island in Tyler county are from the north; Point Pleasant, Indian and McElroy creeks, all three of which are fairly large streams, and Buffalo, Left Buffalo, Shrivers, Gorrell, Muddy, Jefferson and Camp Mistake runs. Those putting in from the south in Tyler county are McKim, Sugar and Sancho creeks, and Gorrell, Jug, Pitts, Wheeler, Conaway, Purgatory, McGee, Big and Short runs.

TOPOGRAPHY OF THE LAND AREA.

The Marshall-Wetzel-Tyler area is a highly dissected plain or plateau of about 1350 to 1400 feet above sea level. The effect of water erosion has reduced this original plateau practically all to slope, the streams flowing in deeply cut, "V" shaped valleys. Numerous hills and ridges, ranging in elevation from 1400 to 1600 feet and capped with more resistant layers of sandstone and rock strata, remain as evidence of the existence of the original plateau.

On the northwestern side of the area under discussion the Ohio river has cut a deep narrow gorge in this old plateau from ½ to 1 mile wide and 400 to 600 feet deep through the nearly parallel strata of sandstone, shales and limestone. The valley walls are usually steep, often almost perpendicular, but on reaching the summits the general surface is rolling except where trenched by creeks and runs. Hard layers of sandstone and limestone often cause inequalities in the surface, the softer portions being eroded away and steep bluffs formed.

South of Middle Island creek and west of Middlebourne erosion seems to have progressed farther and the topography is much more gentle and smooth than in the other portions of the Marshall-Wetzel-Tyler area.

The present flood plain of the Ohio river is represented by narrow strips of rich bottom land along the shore that widen out first on one bank then on the other, and also by a number of islands and bars such as Captina, Fisk Creek, Paden, Williamson, Wells and Grandview islands.

THE RIVER TERRACES.

Along the Ohio river in the Marshall-Wetzel-Tyler area is a series of well defined terraces. These long, narrow, level stretches of land, located one above the other and separated by steep bluffs, are conspicuous topographic features. Moundsville, and Sistersville are built on 2 of these river terraces, while Glendale, Steelton, and Paden City are built on a single terrace.

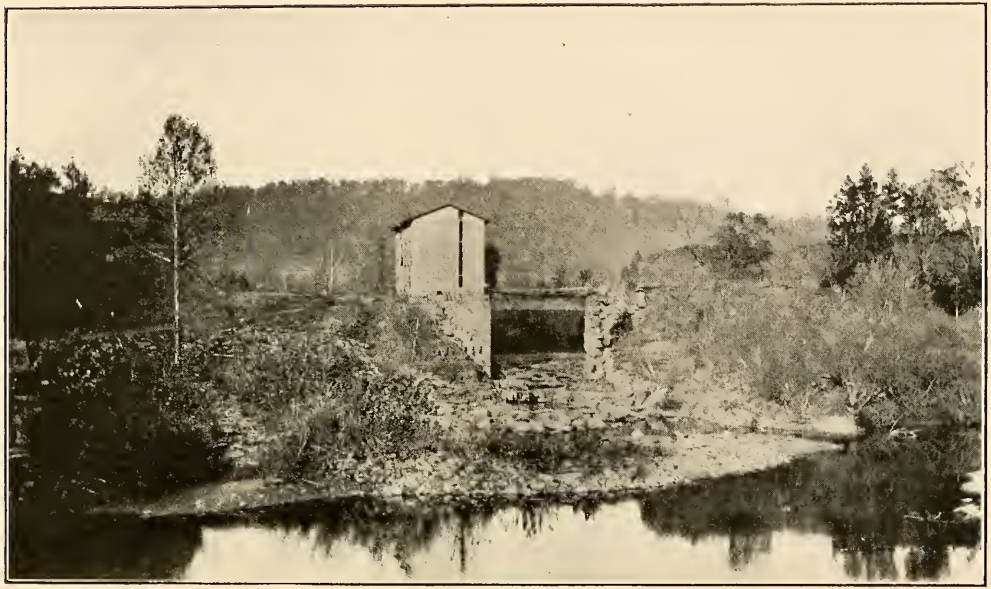

Plate III.—Showing Break-through at Neck of the Famous "Jug" of Middle Island Creek, Tyler County.

The terraces along the Ohio river were first described by Dr. I. C. White[2] in 1876, in Beaver county, Pa. He found five terraces along the river in this county, located as follows:

Fifth terrace.....280 to 300 feet above the river.
Fourth terrace.....200 to 220 feet above the river.
Third terrace.....120 to 130 feet above the river.
Second terrace ..... 60 to 80 feet above the river.
First terrace ..... 30 to 40 feet above the river.

The **first terrace** represents the flood plain of the river and is composed of coarse and fine sand, fine gravel and clay, and includes the various islands and sand bars of the stream. Some of these islands have already been named above with the exception of one, a mile and a half above Sistersville, called Witten Towhead. It forms the broad flat terrace 30 to 40 feet above the river at Round Bottom, Cresaps Bottom, Wells Bottom, Proctor, New Martinsville, just below Sistersville and at Bens Run Station. Often these flood plains are entirely submerged by the almost yearly spring floods, and the soil is greatly enriched thereby, being specially adapted to the corn crop.

The **second terrace** consists of coarser material such as rock fragments, rounded boulders, coarse gravel mixed more or less with fine sand and gravel, and is often worked along the line of the railroad for ballast. A large deposit of a good quality of gravel is worked for ballast in a bank 0.8 of a mile above Woodlands station. About 30 feet thickness of gravel is exposed in this bank.

This terrace ranges from 30 to 40 feet above the lower terrace and about 60 to 80 feet above the river. McMechen, Glendale, Moundsville, Steelton, and Paden City are all built on this high terrace. The eastern half of Round, Cresaps and Wells bottoms are also on this terrace. The second terrace can be traced for a considerable distance up Fish, Fishing, and Middle Island creeks.

The **third terrace** is composed of coarse and fine gravel and sand. It is found at the north and northeast edges of

2. Second Geol. Survey of Penna. Report Q., p. 10.

Moundsville, ranging in elevation from 740 to 760 A. T. It is also found at about the same elevation at the east edge of Round Bottom, east of Steelton northeast of Paden City, south of Sistersville, and ½ mile east of Bens Run station on the north side of Bens run.

The **fourth terrace** is found in three or four conspicuous places along the Ohio in this area. Going down the river, the first prominent place is on the point just south of the mouth of Fishing creek at New Martinsville where it has an elevation of 840 to 860 A. T. This same terrace is found along the river hill at Sistersville, north of Cow Hollow run at 840 to 860 A. T., and at Friendly we find part of the town built up on this terrace, overlooking the river where it has an elevation of 825 to 860 A. T. At about the same elevation we find it again ½ mile northeast of Long Reach.

CREEK TERRACES.

Some of the high Ohio river terraces extend almost to the headwaters of the large creeks in the Marshall-Wetzel-Tyler area.

Wheeling Creek terraces. What seems to be the **third river terrace** is found just below the mouth of Seabright Hollow at about 740 feet above tide: also at about the same elevation just south of the mouth of Grandstaff run, and a short distance east of the mouth of Burches run.

What appears to be the **fourth river terrace** is also found along Wheeling creek in Marshall county. Going up the creek we find it about 840 above tide just north of the mouth of Barnett run, and again from 820 to 850 A. T. just east of the mouth of Burches run, and also opposite the mouth of Wolf run.

One-half mile west of Viola on the north side of Wheeling creek appears to be an old terrace possibly formed at the time of the great ice dam during the glacial invasion from the north. It has an elevation of 1020 to 1050 and corresponds to the level of this old lake terrace found along the banks of the Monongahela river.

Fish Creek Terraces. The second river terrace extends up from the mouth of Fish creek and is quite marked within the bend of the creek to the north just west of Graysville at an elevation of 675 to 680 A. T. It is also well shown at 680 to 690 A. T. opposite the mouths of Little and Big Tribble creeks. This terrace reaches flood plain at Meighen, opposite the mouth of Lower Bowman run.

The **third river terrace** extends up Fish in prominent benches much further. Opposite the mouth of Little Tribble it is found about 740 to 780 A. T.; opposite the mouth of Whetstone about 750 to 780 A. T.; south of Meighen P. O. 760 to 780 A . T. and opposite the mouth of Cedar run, 0.6 of a mile west of Kausooth at about 780 to 800 A. T.

There are also signs of this old ice dam lake terrace at about the same elevation at several different points along Fish creek. Opposite the mouth of Upper Bowman run appears to be a remnant of this old terrace at 1020 to 1060 feet A. T.; also opposite the mouth of Big run at about 1040 A. T.; one-fourth mile due north of Bannen P. O., at about 1020 to 1060 A. T.; opposite the mouth of Long Drain just east of Littleton and also south of the creek just west of Littleton at about 1040 to 1060 A. T. and north of the mouth of Church Fork at the town of Hundred.

Fishing Creek Terraces. The **fourth river terrace** seems to have been the best preserved of any of the other river terraces along the banks of Fishing creek, with the possible exception of the second, a short distance up the creek. This fourth river terrace is found on the long point, 0.4 of a mile due south of the mouth of Doolin run at New Martinsville, at about 840 to 860 A. T.; also at the same elevation opposite the mouth of Little Fishing, and again at 0.8 of a mile northwest of Minnie. About one-half mile west of Jacksonburg what appears to be this same terrace occurs at 840 to 860' A. T. and also on the North fork, south of Barker or Mohr P. O.

Middle Island Creek terraces. The terraces on Middle Island creek are more conspicuous than on any of the other tributaries of the Ohio river in this area. The upper part of the town of St. Marys at the mouth of this creek is built on

the second river terrace at an elevation of 640′ to 670′ above tide. This terrace extends up the valley walls of Middle Island and is prominent at about the same level at Arvilla; also at Shiloh where it is about 650 to 680 A .T. Just north of Bowles Mills (Little P. O.) this terrace has a width of almost one-half mile at an elevation of 660 to 700′ A. T. At Middlebourne and just south of the neck of the "Jug" it is about 700 to 720′ A. T.

What appears to be the third river terrace is found at several points along this creek in Tyler county. On the north side of the creek, ½ mile northwest of Shiloh this terrace is present at an elevation of 740′ to 760′ A. T., and at about the same elevation 0.6 of a mile northeast of Bowles Mills; also on the south side of the creek, one mile above Next postoffice. The town of Middlebourne is mostly built on this terrace where it ranges in elevation from 740′to 770′ A. T. On the southern part of the "Jug" we still find this terrace at 750 to 775′ A. T. The town of Centerville (Alma P. O.) is built on this terrace where it has about the same elevation as on the "Jug", and at the Doddridge county line, ¾ths mile northeast of Deep Valley it has an elevation of 780′ A. T.

The fourth river terrace also seems to be represented on Middle Island. About ¾ths mile due north of Shiloh what appears to be this same terrace has an elevation of 840′ to 860′ A. T., and at about same elevation and distance northeast of Bowles Mills we find it again: also on the north side of the creek, southeast of Middlebourne, and about the central portion of the "Jug" it occurs at about the same elevation. Coming on up Middle Island to Centerville, we find it both northeast and southwest of the town at about 840 to 870′ above tide, and just before the Doddridge county line is reached, ½ mile N. 10° E. of deep Valley, we find this terrace quite wide at an elevation of about 850 to 880 feet above tide.

It is very probable that the various creek terraces heretofore described owe their origin to the same natural forces that were instrumental in checking the flow of the Ohio river at times and forming those along the Ohio river front.

THE OHIO RIVER.

The Ohio river bounds the Marshall-Wetzel-Tyler area on the northwest. Its entire length as determined by the U. S. Government engineers from Pittsburg, Pa., to Cairo, Ill., is 967 miles, and its length along the area under discussion, from Benwood to Bens run at the Pleasants county line, is 55 miles, in which distance it has a total fall of 28 feet or 6 inches to the mile.

Prof. G. Frederick Wright has the following to say about this river:

[3]"The Ohio is still the most remarkable of all the rivers in the world for the extent and suddenness of its fluctuations in volume; at one time being so shallow that in places a child can ford it, while at other times it is a raging flood, a mile in width and seventy feet in depth. But, during the time when the ice of the glacial period reached its most southern point of extension, the Ohio above Cincinnati was a slack water stream, six hundred feet in depth, so that a ship could sail 300 feet above the site of Pittsburg."

The river's geological history and terraces have already been described.

The River Channel.

In his Panhandle report, page 32, Prof. Grimsley has the following to say about the channel and Wheeling record of flood stages of the Ohio river:

"By act of Congress, June 3, 1896, the sum of $25,000 was appropriated for a survey of the Ohio river from Marietta to Pittsburg. This survey was made under the direction of Major W. H. Bixby, Corps of Engineers, who made his report December 28, 1898. This report was published by the House of Representatives as document No. 122 of Fifty-fifth Congress (third session) January 7, 1899, and forms the basis of the following discussion:

"The floor of the main channel of the Ohio river is very

3. Ice Age in North America, page 358.

irregular, giving a depth of low water varying from less than 2 feet to 31. Where the river enters the Pan Handle (low water 646.5) the channel reaches a depth of 14 feet, while at Line Island it is only 2 feet. At the location of dam No. 8, two miles below East Liverpool, there is a depression of 25.6 feet, and the depth of water will be increased 10.7 feet. Opposite New Cumberland the channel is 3 feet deep at low water, and two miles and a half below town is 17.8 feet. Three miles and a half below New Cumberland is the location made for dam No. 9, where depth of water at low water stage is 13 feet, which will be increased by the dam 11.5 feet. The distance between dams 8 and 9 is 13.5 miles with a fall of 7.8 feet

"Dam No. 10 is to be located 5⅔ miles below No. 9, and 2¼ miles above Steubenville, where the channel is 13 feet deep at low water and will be raised 12.3 feet. Just above this location is the deepest place in the river channel between the mouth of Little Beaver river and Marcitta, reaching 31.2 feet below low water. Eleven miles below No. 10 is No. 11, two miles and a half below Wellsburg where the channel is 6.4 feet deep and will be raised 12.1 feet. This dam is now under construction with the concrete masonry of the locks nearly completed. The distance between Nos. 8 and 11 is 30 miles, with a fall of 23.2 feet or .7 foot to the mile.

"Dam No. 12 is to be located 10½ miles below No. 11 and three-fourths mile above Martins Ferry. The present depth of water here is 5.2 feet and will be raised to 11.5. Dam No. 13 is now under construction 9 miles below No. 12 and one and two-third miles below the B. & O. railroad bridge at Benwood Junction. The depth of water at low stage is 3.9 feet and will be raised to 16.7.

"The locks at dams 8, 12 and 13 will be on the West Virginia side of the river while 9, 10 and 11 will be on the Ohio side. These locks will be at least 600 feet long, 110 feet wide, with 6 feet navigable water in lower pool and 7.6 feet lift. The total cost of one of these dams and locks was estimated in this preliminary survey at $850,000.

Cross Sections of the River.

"In the preliminary work on the location of dams 8, 11, 13, borings were made across the channel to determine the amount of filling in the old river valley, or depth to the rock floor. These records have been kindly furnished by Major Geo. A. Zinn, engineer in charge of Ohio river work.

"At the East Liverpool dam (No. 8), the first terrace of the river, 40 feet high, is composed of gravel and sand which extends 32.9 feet below low water of the river. At this depth is found a blue slate. The average distance below low water to bed rock at this place is 32.5 feet and the rock floor appears to be nearly horizontal.

'Below Wellsburg (No. 11), the lower terrace is 40 feet above the river composed of sand and gravel which extends to 29 feet below low water to a sandstone bed rock. This rock is also about horizontal and 32.5 feet below low water. The water increased in depth from 2.2 feet on West Virginia side to 5.8 on the other side. The rock floor at this dam is 125 feet below the Ames fossiliferous limestone which crops in the hills above, and may represent the Buffalo sandstone which in other sections is found at nearly this interval.

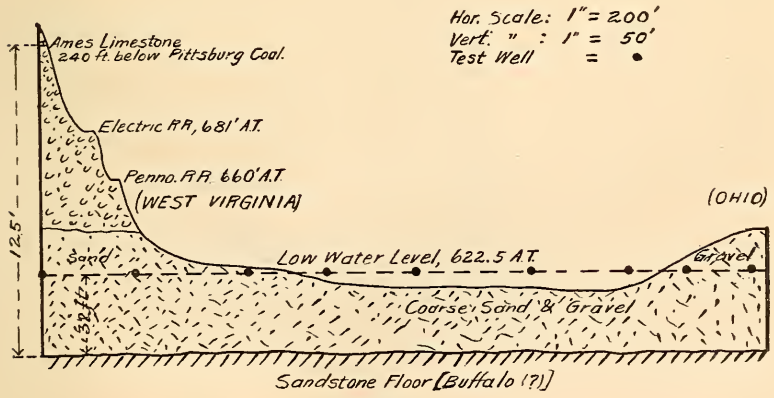

Fig. 1.
Cross Section of Ohio River Channel at Dam 11, Below Wellsburg.

"At the dam below Benwood Junction (No. 13, the average thickneess of sand and gravel fill to the rock floor is 30

feet, but the rock floor is cut down to 49 feet near the West Virginia side. The average distance from the low water level of the river to the rock floor is 34 feet, being now filled with sand and fine gravel for 32 feet. The navigable channel of the river is cut in this sand fill to varying depths giving a very irregular profile of the channel floor.

Maximum and Minimum River Stages at Wheeling.

"The following data on maximum and minimum river stages at Wheeling have been furnished by Mr. Alex. McAshley local forecaster of the United States Weather Bureau at Pittsburg.

"These observations, extending over a period of 25 years, show the highest record stage of the river at Wheeling 46.5 feet on February 8, 1884; the next highest was 44.6 feet on February 19, 1891. The maximum stages in the different years are found in the months of January, February, March, April, though it has been reached once each in May, June, August and November. The river reached a stage of over 40 feet in six years out of the 25, and over 30 feet in 11 years. The lowest maximum recorded was 1.4 in October 1892, and it was four feet or under in 21 months of the 25 years.

"The lowest stage of water in the 25 years was 0.3 on August 27, 28, 1893. It was 0.2 September 8, 1894. It has been less than one foot 12 months in the 25 years, and these months were in seven years during August, September, October and November. The highest minimum recorded was 14 feet in February, 1891.

"The average stages during the 25 years show the average maximum stage in March, and the lowest maximum in September. The average minimum stage was in September and the highest minimum in April.

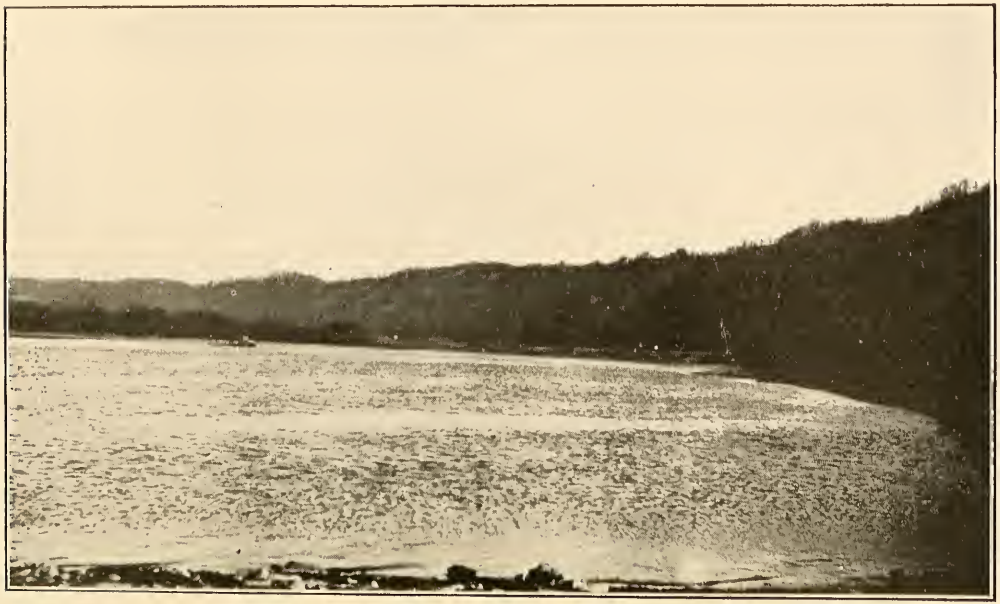

Plate IV.—Showing Steeps Bluffs Along the Ohio River Front of Marshall County, Northeast From the Mouth of Hog Run Near Powhatan.

Maximum River Stages at Wheeling, 1882-1906.

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov	Dec.
1882	....	....	....	....	21.2	18.0	15.8	9.3	10.0	9.8	5.7	9.8
1883	17.0	35.5	10.3	22.5	....	....	....	....	....	....	....	....
1884	....	46.5	30.5	17.6	9.8	11.0	10.5	9.8	3.1	5.6	5.8	16.5
1885	32.8	10.8	15.3	24.3	9.3	12.3	7.0	15.9	9.8	11.8	9.6	16.8
1886	29.3	31.0	21.5	32.0	15.0	12.0	6.5	8.3	5.8	6.6	22.0	16.5
1887	24.3	33.8	24.0	14.8	15.5	16.0	4.6	3.2	2.0	....	5.0	5.8
1888	29.8	16.0	19.6	22.0	11.0	8.6	27.1	32.2	11.0	15.5	18.0	16.0
1889	19.0	23.0	17.1	21.0	15.2	28.9	13.6	7.8	4.0	11.0	17.4	19.5
1890	27.8	24.9	32.5	27.2	27.5	10.9	7.0	10.0	24.7	22.9	17.6	14.8
1891	32.9	44.6	19.0	20.9	6.0	15.8	13.0	11.9	7.3	3.0	15.0	17.8
1892	29.0	19.0	23.0	16.0	18.0	23.3	9.5	5.0	3.5	1.4	6.7	11.0
1893	....	32.1	24.8	23.9	31.5	7.0	6.7	4.0	6.9	7.5	9.8	20.5
1894	13.0	22.5	19.3	16.1	28.9	10.9	3.9	2.4	14.0	3.6	7.2	12.5
1895	36.0	7.0	22.2	26.9	6.0	4.1	5.5	3.5	3.3	1.9	9.6	18.5
1896	14.9	19.9	28.4	29.9	9.6	11.3	27.3	22.1	5.0	15.6	11.7	15.9
1897	9.9	37.0	28.0	20.7	18.8	7.9	13.8	7.8	3.0	2.1	13.6	18.9
1898	27.5	21.4	43.9	23.0	16.9	9.9	5.5	17.5	4.4	18.7	21.1	22.8
1899	24.3	20.6	28.2	21.3	22.6	9.8	8.4	6.2	5.9	2.8	7.3	17.7
1900	23.3	25.0	24.9	11.0	6.6	9.5	8.3	6.5	3.0	3.2	34.3	18.0
1901	18.0	8.4	29.0	41.3	25.0	20.5	7.9	7.7	9.0	4.4	14.6	33.9
1902	21.6	17.7	42.0	32.9	8.6	7.9	24.0	11.9	2.6	10.5	11.0	25.6
1903	25.5	34.6	40.2	19.5	8.1	14.7	12.7	11.9	11.7	10.3	16.3	9.9
1904	34.2	26.3	38.5	33.9	18.2	17.0	14.2	5.1	3.4	4.9	3.9	16.4
1905	17.4	17.6	42.9	14.4	14.4	16.3	9.9	13.4	10.7	15.9	12.6	31.6
1906	24.3	8.6	25.9	26.6	9.6	15.4	4.9	15.3	4.7	9.0	18.0	....
Average..	24.1	24.3	27.1	23.3	15.5	13.3	11.1	10.1	7.1	8.1	12.8	17.6

Minimum River Stages at Wheeling 1882-1906.

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1882	....	....	....	....	6.2	6.8	3.4	3.2	3.7	3.0	3.2	3.5
1883	4.3	10.0	7.5	10.0	....	....	....	....	....	....	....	....
1884	....	10.2	7.0	6.7	5.5	4.3	2.8	2.6	1.6	1.7	2.5	3.8
1885	5.2	4.8	3.8	9.5	5.3	3.8	2.3	3.3	2.9	1.8	5.7	6.0
1886	6.6	5.5	5.2	5.7	4.8	2.8	2.1	2.3	1.5	1.3	1.5	5.5
1887	5.1	13.3	6.2	5.8	4.6	2.6	1.0	1.3	1.0	....	1.1	2.7
1888	4.1	7.6	7.2	6.1	4.9	1.9	2.8	2.0	3.2	2.6	7.4	7.0
1889	7.4	5.5	6.4	6.5	6.5	7.9	4.4	2.0	0.9	2.6	6.9	8.1
1890	8.6	9.8	8.0	5.9	9.9	5.0	1.8	1.9	4.0	7.0	7.0	3.9
1891	7.0	14.0	9.0	5.5	2.6	4.9	4.0	2.3	1.2	0.9	1.7	6.3
1892	6.3	6.8	6.0	6.4	5.8	5.6	2.7	1.7	1.2	0.9	0.9	5.0
1893	....	8.5	8.4	7.3	7.1	3.0	1.5	0.3	1.2	1.7	2.7	6.9
1894	5.9	6.9	6.9	6.8	4.4	3.2	1.3	1.3	0.2	2.1	3.1	4.5
1895	4.0	3.9	9.3	5.7	3.9	1.7	2.3	1.2	1.3	0.6	0.8	2.9
1896	3.9	5.9	6.7	7.8	3.8	4.3	4.5	3.1	2.3	5.0	4.8	4.2
1897	5.4	9.5	8.9	7.0	4.9	3.6	2.8	3.0	0.9	0.4	0.5	6.2
1898	6.3	5.8	7.0	7.1	7.2	3.7	1.7	4.3	1.5	1.6	5.6	4.9
1899	7.6	5.1	9.7	6.6	5.8	4.0	2.8	1.3	1.0	1.1	1.8	4.0
1900	7.7	4.9	7.7	7.0	3.6	3.3	2.7	1.2	0.3	0.3	1.6	4.9
1901	4.4	4.5	6.3	11.3	6.7	7.3	2.2	1.7	3.2	1.9	1.5	7.2
1902	4.0	4.8	7.9	6.3	4.8	3.8	6.0	2.4	1.1	2.9	2.4	6.8
1903	6.9	7.8	10.0	6.9	2.7	3.4	3.9	2.4	1.8	2.2	2.9	3.0
1904	4.9	4.0	9.3	7.3	5.6	4.9	3.6	1.6	1.3	2.6	1.3	1.4
1905	3.1	4.4	13.4	7.3	4.9	5.0	4.3	4.5	2.8	2.8	5.0	5.9
1906	7.4	4.2	6.1	8.3	4.3	4.1	2.1	2.8	2.7	2.9	4.5	....
Average..	5.8	5.7	6.8	7.1	5.2	4.2	2.8	2.1	1.7	2.1	3.1	4.9

The U. S. Engineer Office at Wheeling gives the following stages for high and low water at that place for the years 1907 and 1908:

Date.	High Water Feet.
Jan. 20, 1907	37.0
March 15, 1907	50.1
February 16, 1908	42.8
March 20, 1908	39.6

Date.	Low Water Feet.
August 19-20, 1907	2.8
Sept. 30-Oct. 9, 1908	0.0

Ohio River Flood Records.[4]

"The following table of Ohio river flood records is often given, but the authority for the figures is not known to the writer, and they do not agree exactly with the records given above:

Date.	Pittsburg.	Wheeling.	Diff.
November 10, 1810	32.0	48.0	16.0
February 10, 1832	35.0	48.1	13.1
April 20, 1852	31.9	48.0	16.1
April 13, 1860	26.7	43.0	16.3
September 30, 1861	30.0	44.2	14.2
April 23, 1862	27.9	37.0	9.1
March 19, 1865	31.4	41.0	9.6
December 15, 1873	25.6	40.8	15.2
January 9, 1874	22.4	38.8	16.4
December 12, 1878	24.9	34.9	10.0
June 21, 1881	25.6	40.9	15.3
February 19, 1883	25.8	39.7	13.9
February 7, 1884	33.6	52.4	18.8
February 18, 1891	31.3	44.1	13.8
January 8, 1895	25.9	36.2	10.3
February 24, 1897	24.5	37.1	12.6
March 24, 1898	28.5	44.6	16.1
April 22, 1901	28.0	41.9	13.9
March 2, 1902	32.4	43.3	10.9
March 2, 1903	29.0	40.3	11.3
January 24, 1904	30.1	44.2	14.1
March 4, 1904	29.1	39.3	10.2
March 22, 1905	28.8	42.7	13.9

4. Ohio-Brooke-Hancock Report, p. 36, W. Va. Geol. Survey.

PART II.

The Geology of the Marshall-Wetzel-Tyler Area.

CHAPTER III.

GEOLOGIC STRUCTURE.

INTRODUCTION.

The structure or lay of the beds of the Marshall-Wetzel-Tyler area is very simple. The rocks are bent into a number of nearly parallel wrinkles or folds, having a general northeast-southwest trend. In describing these folds the upward bending arch is called an **anticline** and the downward bending trough a **syncline.** The **axis** of any fold is the line joining the highest points of any anticline or the lowest points of any syncline, and from which the strata dip in an anticline and to which they dip in a syncline. The **strike** is the direction of the horizontal edges of dipping beds and is generally though not always parallel to the axis of a fold, diverging from it when the axis is not horizontal. The sudden fall of the axis of an anticline forms what is called the **nose** of the fold. The original position of rock beds, whether formed by sedimentation or from lava-flows, is normally horizontal. Both kinds of deposits, however, may take place on considerable slopes. Earth movements cause modifications of this original attitude and produce the above described structural forms very generally used in geology.

Method of Representing Structure.

There are two methods generally used in representing geologic structure. One of these is by cross sections which show the strata as they would appear if a deep ditch were dug across the entire area under discussion. This method is very satisfactory when the dip of the rocks is perceptible to the eye. In the Marshall-Wetzel-Tyler area the folds are so slight that this method would not at all be satisfactory without greatly exaggerating the vertical scale of the cross section in comparison to the horizontal; again this method would only give an idea of structure along certain lines, and not give the shape of the arches or basins, which is of the greatest importance in the commercial development of the Marshall-Wetzel-Tyler area, as regards both the future mining of its coal, and the exploitation of its oil and gas fields.

A second method of representing structure, which has been used by the United States Geological Survey in the bituminous coal fields of western Pennsylvania, consists in the representation by contour lines of the position of some particular stratum. This stratum is generally one that is known through its wide exposure in outcrop, its exploitation by mines, its relation to some other bed above or below it, or its wide use as a key rock by the drillers for oil and gas. These contour lines show in a general way the form and size of the folds into which the key stratum has been thrown and its altitude above the level of the sea at all points.

In the area under discussion the writer took the Pittsburg coal bed as a key rock as it is the most widely known and positively identified stratum and is the one most generally used as a key rock by the drillers for oil and gas over the three counties to determine the position of the oil and gas bearing sands. With the exception of a small area along the Ohio river front along the northwest corner of Marshall County, this coal bed lies deeply buried below the surface. It is true that this seam in commercial thickness is not present in Tyler and the western half of Wetzel, but in a great number

of scattered wells over this barren portion, the blossom or slaty material has been noted at the proper horizon, and in this way the writer was enabled to supply the approximate position of this bed in other wells, when not noted, as if actually present. Also the interval of this coal bed above the top of the Big Injun Sand was used in many wells to determine the position of the coal when not recorded in the well.

The roof or top portion, instead of the floor, generally taken, has been selected by the writer as the surface on which to represent the geologic structure of the area, since the logs of many oil and gas wells on which levels were taken, record only the depth to the top of the seam and omit to report the thickness.

The altitude of the Pittsburg coal seam has been determined from its elevation at only one or two points at its natural outcrop in the area, but at several where mined by shafts along the Ohio river. The greatest source of information was from levels on the many oil and gas wells through the seam in which the top was most generally noted. After its altitude has been determined at a great many places, points of equal altitude are connected by contour lines; for example, all points having an elevation of 200 feet above mean tide are connected by a line which then becomes the 200 foot contour. In like manner all points having an elevation of 250 feet are connected by 250 foot contour lines; and so on contour lines are drawn, showing vertical distances of 50 feet throughout the entire area. These lines are printed on the structure and economic geology map, accompanying this report in a separate map case, and show not only the approximate heighth of the top of the Pittsburg coal above sea level, but both the horizontal contours of the troughs and arches, and the dip of the beds. Hence the depth of the Pittsburg coal or reference stratum at any point is obtained by subtracting its elevation as shown by its structure contour line, from the elevation of the surface at the same point as shown by the topographic map. For instance, suppose the position of the Pittsburg coal at Wileyville, Wetzel County, is desired. It will be seen by a glance at the map that the elevation of

the surface is 800 feet A. T. at this point, and that the 50-foot structure contour passes through the same place. The coal is here then about 800 minus 50 feet, or about 750 feet below the surface.

As a rule, these structure contours are only approximately correct from the very nature of the data from which they are made, being estimated on the assumption that over small areas the rocks maintain a uniform thickness, when it is a well known fact that in some places the interval between two easily determined strata will vary many feet in a short distance. It follows then that the position of the contour will be in error the amount the increase or decrease in thickness varies from the calculated thickness.

Another cause of error is the nature of determining the elevation of the outcrop of the key stratum, or of the tops of the many oil and gas wells drilled down through the same. In many cases these altitudes were determined by spirit level, but the great majority were determind with the aneroid barometer. The aneroid was checked as frequently as possible on the spirit levels of the U. S. Geological Survey left at conspicuous points along the public highways in the preparation of their accurate topographic map of the Marshal-Wetzel-Tyler area in co-operation with the State of West Virginia. In this way the instrumental error is kept down. The errors may accumulate, or may compensate one another, but in any case it is believed that their sum is less than one contour interval, that is less than 50 feet, and over much of the area of Marshall and eastern Wetzel the possible variation from actual altitude will not likely be more than 15 to 25 feet.

Detailed Geologic Structure.

The Marshall-Wetzel-Tyler area occupies the central or deepest portion of the Appalachian basin or geo-syncline which enters West Virginia from Greene county, Pennsylvania. Dr. I. C. White[1] has the following to say concerning this geo-syncline:

1. W. Va. Geol. Survey, Vol. II, pp. 84-85.

"The central or deepest portion of the Appalachian basin or geo-syncline enters West Virginia from Greene county, Pa., at the southwest corner of the latter state, and crossing Western Monongalia and eastern Wetzel counties, continues on through the State in a general southwest course across eastern Tyler, western Doddridge, central Ritchie, Wirt and Jackson, cutting eastern Mason and western Putnam, and central Cabell, to enter Kentucky from northern Wayne, ten miles above the mouth of the Big Sandy river. Where the axis of this great basin enters the State, and on to the southwest as far as Doddridge county at least, the Pittsburg coal is buried to a depth of 1300 to 1500 feet under the highest summits, or say 150 to 200 feet above tide, but from Doddridge county on southwestward, the basin begins to rise, and at the Kentucky line the Pittsburg coal overlooks the Big Sandy waters from an elevation of 800 feet above tide in the deepest portion of the trough."

From the axis of this geo-syncline in the Marshall-Wetzel-Tyler area the strata has a general rise both to the northwest and southeast that is interrupted by several low folds none of which hold their identity across the entire area. These folds consist of six anticlines and seven synclines that were prominent enough to be observed, and are shown by the contour lines on the map accompanying this report, and represent the lines of equal elevation of the top of the Pittsburg coal seam. These folds will now be described in the order of their succession across the area from east to west.

Hundred Anticline. This arch in the rocks is well developed in the eastern part of Wetzel county which it enters from Greene county, Pa. It extends entirely across Church district into Grant and on south to a point about one mile north of Pricetown where it dies down. The axis crosses the B. & O. railroad within the corporation limits of the town of Hundred from which the writer has given the arch its name, since it does not seem to extend far to the northeast as revealed by the studies of R. W. Stone and F. G. Clapp of

the Greene County Oil & Gas Fields[2]. In fact it was not noted on their contour map. Where it crosses the State Line the Pittsburg coal (top) has an elevation of about 320′ A. T., and about 310′ A. T. at Hundred. At the southwest end of the arch, where it crosses Willey Fork of North Fork, two miles above Mobley, the coal has an elevation of 368′ A. T., but dies down rapidly southward within three miles to less than 250 feet A. T. to the general level of what the writer has termed the **Smithfield terrace.** The location of the axis in the vicinity of Earnshaw is not as definitely determined as at other points along the arch, since no wells had been drilled close this town.

Burchfield Syncline. The structural basin which lies west of the Hundred anticline has been termed the Burchfield syncline by the writer from the town of Burchfield at the point where the axis crosses Willey Fork of Fishing creek. The axis of the syncline enters the area from Greene county, Pa., about one-half mile west of the crest of the Hundred anticline and sweeps in a general direction of about S. 20° W., crossing the Short Line R. R. at Archer, one mile below the mouth of Arches fork. The axis of the trough in the northern portion is on the average about one to two miles west of the axis of the Hundred arch but diverges rapidly to the westward in the southern portion. Along the axis of the syncline the Pittsburg coal varies from slightly under 250′ A. T. in the north half to slightly less than 200′ A. T. in the southern, where the trough appears to swerve to the west, widen out and form what the writer has termed the **Stringtown terrace** in the extreme eastern portion of Tyler county. It crosses the main line of the B. & O. R. R. about one-half mile west of the mouth of Rock Camp run, and appears to be the continuation of the same basin lying just to the east of New Freeport, Greene county, Pa., but not named in U. S. Geological Survey report on that county.

Littleton Anticline. The littleton anticline enters Wetzel county also from Greene county, Pa., crossing the State Line 2.6 miles due east of the southwest corner of the

2. Bulletin No. 304, U. S. G. Survey.

latter state and its general direction is about S. 20° W. for the first five miles in the county where it diverges westward to about S. 40°- 50° W. until it crosses Fishing creek, one mile below Jacksonburg, where it again appears to make a sudden turn to the southeast and dies down within a short distance (two to three miles) into the Stringtown Terrace. It crosses the West Virginia fork of Fish creek about one mile east of Littleton from which place the writer has given it its name. This arch was noted for about two miles north of the Mason & Dixon (State) line in the U. S. G. Survey report of Greene county but not named. It passes on southwest from the Littleton region just to the east of Anthem, crossing Knob fork at Kodol one mile above Uniontown, and the North Fork of Fishing creek just above Lowman (Kingtown). Along the axis of this arch the elevation of the Pittsburg coal or Key rock is about 325′ A. T. where it enters the State, but is less than 300′ A. T. in the southeast corner of Center district, Wetzel county, where it flattens down for about four miles but rises above 300′ A. T. when it enters Grant district and averages about 325′ A. T. on southwest to Fishing creek. The eastern slope of this arch down to the axis of the Burchfield syncline is short in comparison to its slope on its western flank where it averages five to six miles down to the axis of the next syncline on the west, or a total dip of 275 feet as compared with 125 feet the maximum dip on the eastern flank.

Nineveh Syncline. The Nineveh syncline is the most pronounced trough in the entire Marshall-Wetzel-Tyler area, and is located about the middle of the Appalachian basin and is probably its deepest trough. It was named by Prof. J. J. Stevenson in 1876 from the village of Nineveh, Greene county, Pa., where it is a prominent structural feature. It crosses the southwest corner of Marshall county about one-half mile northwest of the west end of Boardtree tunnel in a S. 45° W. course, crossing Rocky run of Fish creek about one-half mile from its mouth near Rockport, and thence on southwest through Clyde and Wileyville, and terminating about two miles southwest of Halls Mills. The deepest por-

tion of this trough is between Wileyville and Clyde where the Pittsburg coal dips down to only fifty feet above sea level, the lowest elevation yet reported for this Key rock in the Appalachian basin. The contour lines on the western flank of this trough are not as accurately determined as on the eastern side, especially in the vicinity of Newdale, West and Silver Hill villages. From a "V" shaped trough in Marshall and northern Wetzel it widens out in the vicinity of Wileyville, the axis rising very fast southwestward from the latter point, and in this region the basin resembles a rude shaped canoe.

Washington Anticline. From the trough of the Nineveh syncline near Boardtree the rocks rise rapidly to the northwest and form a high anticlinal fold which enters Marshall county from Greene county, Pennsylvania at Rocklick in the northeast corner of Cameron district, elevating the Pittsburg coal at this point to over 550′ A. T., or a total rise of 450 feet in the 8 1-2 miles due northward, or at a rate of 53 feet to the mile. This anticline was named from the town of Washington, Pa., near which point it is a prominent structural feature and from which it extends on southwest through Greene county, Pa., through Jacksonville, crossing the South fork of Wheeling creek one-half mile above Ryerson Station. From Rocklick, Marshall county, it sweeps southwestward, having a bearing of about S. 20°-25° W., crossing Grave creek about one mile east of Cameron. It crosses Fish creek about one-half mile below (west of) Kausooth, but has veered here to a S. 50° W. course, passing through Howard in the southwest corner of Liberty district and entering Wetzel county in the northeast corner of Proctor district. It crosses Proctor creek near its head, slightly over a mile northwest of Beebe, and thence on southwest, crossing the Proctor-Magnolia district line near Green Hill P. O. where it takes a sudden turn to the southeast and crosses Little Fishing creek about one-half mile below Maud P. O. It disappears soon after crossing Little Fishing. The elevation of the Pittsburg coal along the axis of this arch falls very rapidly to the southwest from Rocklick and by the time

Cameron is reached it has fallen from over 550′ A. T. to less than 450′ A. T. and thus forms here a very prominent nose of the arch. The rapid fall of the axis continues on southwest to about one-half mile north of Kausooth where it is less 250′ A. T. From Kausooth on southwest to Little Fishing creek the Pittsburg coal on the crest of this arch does not much exceed 250′ A. T. and is probably not over 50 to 75 feet above the same Key rock in the synclinal basin next on the west.

Loudenville (Finney) Syncline. This structural basin lies next on the west of the Washington anticline in the Marshall-Wetzel-Tyler area. It may correspond to the Finney syncline as named by Griswold & Munn[3] in their report on the oil and gas fields in the vicinity of Washington, Pa., where it is the next structural basin on the west of the Washington anticline. It is the longest continuous fold in the rocks in the area under discussion and extends almost entirely across both Marshall and Wetzel counties. It enters Marshall from Ohio county about one mile west of the town of West Union in the extreme northeast corner of Sand Hill district, and bears S. 45°- 50° W., crossing Wheeling creek about two miles N. 80° W. of Viola. Within a short distance (two miles about) after crossing Wheeling creek, it appears to swerve to the southeast, passing about one-half mile east of Limestone P. O., and about the same distance west of Pleasant Valley and Beelers Station. Lack of sufficient surface data as well as oil well records in the vicinity of these three towns make it a hard matter to determine the exact location of the axis of the trough, and for this reason it is only dotted in on the map. From Beelers Station it runs almost due south, crossing Grave creek at Loudenville, to Big run, and then bears S. 45°- 50° W, crossing Fish creek about three-fourths mile east of Adaline. It crosses the Marshall-Wetzel county line about one-half mile west of the latter's intersection with Lynn Camp run. From this point it extends on southwest crossing Proctor creek near Andy, and Doolin run near the mouth of Camp run, and finally terminat-

3. Bul. 318, pp. 53-54, U. S. Geol. Survey.

ing about one-half mile northwest of Porters Falls. Along the axis of this syncline the elevation of the Pittsburg coal or Key rock varies from 150′ A. T. on Little Fishing to about 475′ A. T. in the Wheeling creek region of northern Marshall county. From the Ohio-Marshall county line southwest to about three-fourths mile northwest of Beelers Station the axis of the trough does not vary much in level, the Pittsburg coal ranging between 450′ and 500′ A. T., but from Beelers Station southward it falls rapidly, the Pittsburg coal dropping from 450′ A. T. to less than 250′ A. T. at Big run of Fish creek. From the latter point on southwest to Proctor creek the Pittsburg coal along the axis of the basin does not appear to be over 50 to 75 feet lower than the same stratum on the crest of the Washington anticline on the east.

New Martinsville Anticline. This arch in the strata was named by the writer from the town of New Martinsville through which point the anticline passes near the southwest end of the fold. This arch seems to have its northeast terminus near the mouth of Upper Bowman run of Fish creek in Meade district, Marshall county, and takes a southwest course from there, passing through the divide between the head of Long run and Rocky fork of Whetstone creek, slightly over one mile southeast of Ella, and crossing Proctor creek just above the mouth of Left fork, finally dies down about two miles southwest of New Martinsville, passing nearly through the center of the latter place. The Pittsburg coal along the axis ranges from 250′ A T. southwest of New Martinsville to over 400′ A. T. at the Wetzel-Marshall line. The arch seems to flatten out between Proctor creek and New Martinsville, forming a "flatiron" shaped terrace.

Proctor Syncline. This basin is the last fold of the rocks noted to the west in Marshall county. It appears to start on the north side of Fish creek in Meade district, about one mile and a half northwest of Meighen P. O. From this point it bears nearly due southwest crossing Fish creek near the mouth of Whetstone creek and Burch Ridge about 2 1-2 miles southeast of Franklin, where it swerves to the south and reaches the Ohio river at Proctor from which place the

writer has given it its name. Lack of sufficient oil well records and surface data prevent the accurate determination of the axis but it is approximately correct as shown by the map accompanying this report.

Robinson Syncline. This structural basin lies in the extreme southeast corner of Wetzel county just east from Robinson station from which the writer has given it its name. It may however correspond to the Waynesburg syncline of Greene county, Pa., which can only be determined definitely when the detailed geology of Monongalia county is taken up. Along the axis of this syncline the Pittsburg coal reaches almost as low an elevation (75′ A. T.) as at Wileyville in the Nineveh trough. From this trough the Pittsburg coal rises rapidly westward to slightly over 200′ A. T. within a mile and a half and then flattens out forming the **Smithfield terrace.**

Big Moses Anticline. The most pronounced arch in the Marshall-Wetzel-Tyler area is an anticline whose northeast terminus is about two miles south of Wileyville, Wetzel county, which takes a southwest course from here across southern Wetzel, and entirely across Tyler county. It is named by the writer the Big Moses anticline from the town of Big Moses near its crest in the latter county. Its course from the northeast end is about S. 45° W., crossing the head of Shenango creek three-fourths mile southeast of Brown P. O. and Fishing creek about one mile above Reader, where it veers to S. 20°-25° W. and passes through Atwood P. O. on the Wetzel-Tyler county line near the head of Brush run of Fishing creek. From this point it keeps approximately the same southwest course to a point about one mile and a half north of Big Moses where it swerves to the southeast for nearly two miles crossing Indian creek a mile above Big Moses. The arch again resumes nearly the same southwest course as before, crossing McElroy creek near the mouth of Pratt run, about one mile N. 75° W. of Shirley. From this point it passes one mile to the east of Wilbur and crosses the Tyler-Doddridge county line at Camp P. O., two miles northeast of Deep Valley. The elevation of the Pittsburg coal or

Key stratum along the axis of this great fold varies from 325′ A. T. on the head of Shenango creek, Wetzel county to 425′ A. T. at Camp P. O. where it passes into Doddridge county. The authority for this arch in the rocks on the head of Shenango is the Brown core test (W 228), drilled by S. W. Meals, in which the Washington coal was struck at 130 feet in depth, and the elevation of the latter coal at this point was about 775′ A. T. The test stopped at a depth of 530 feet and must have ended 50 feet or more above the top of the Pittsburg coal seam, since the latter should come about 450′ to 460′ below the Washington coal as revealed by the same interval in the Pine Grove boring, two miles to the southeast. The Pittsburg coal then should have an elevation of 775 less 450 feet or about 325 feet above tide in the Brown core test as opposed to 260′ A. T. at Pine Grove. After crossing Fishing creek the axis of the arch rises and brings the Pittsburg coal above 350′ A. T. It holds practically this same level on southwest to McElroy creek, southwest of which it raises the key rock to over 400′ A. T. The most conspicuous feature of this arch is the sudden bend or kink of the axis to the southeast near Big Moses.

Middlebourne Syncline. The structural basin or trough next on the west of the Big Moses anticline is the Middlebourne syncline, named by the writer from the town of Middlebourne, Tyler county, near which place it passes on the southeast in its course across Tyler county. The location of the axis of this trough is the most difficult to determine of any yet described in the three counties, since the Pittsburg coal is absent from most well records in this region and also unconcealed persistent key rocks in the surface geology appear to be wanting. The axis, as outlined on the economic geology map accompanying this report is a close approximation from the data in hand. Its northeast end appears to be near Lonetree P. O. on Elk Fork of Point Pleasant creek from which point it appears to take a S. 30° W. course, crossing Middle Island creek 2 1-2 miles southeast of Middlebourne. In the W. W. Allen No. 1 oil well (T 102), located about one mile N. 75° E. of the neck of the "Jug" and

2 1-2 miles east of Middlebourne, the Pittsburg coal reaches the lowest elevation, 225′ A. T., yet reported in Tyler county west of the Big Moses anticline. After crossing Middle Island creek the axis of the trough appears to keep on its southwest course to the head of Foster run of Sancho creek, 2 3-4 miles due west of Alma (Centerville) where it bends more to the south and passes successively near the heads of Sancho Fork, Davis and Pyles runs of Big Sancho creek, through the most northern point of Ritchie county and finally leaves Tyler 2 1-2 miles S. 15°-20° W. of McKim P. O.

As said above the location is only an approximation and is based on the assumption that the interval from the top of the Big Injun sand up to the top of the Pittsburg coal remains fairly constant along this southwest course. That this interval does increase rapidly to the southeast is very apparent from the W. W. Allen well (T. 102,) above mentioned, where it is 1242 feet, while in the John Groves No. 1 well (T. 145) the same interval has thickened up to 1337 feet, or an increase of 95 feet in 6 miles air line measurement, or at the rate of almost 16 feet to the mile. This same interval in the J. R. Baker No. 1 well (T. 111), 2¼ miles south of Middlebourne and the Moses Johnson No. 1 well (T. 229), one mile northwest of McKim, is 1225 and 1217 feet respectively, and the line joining the two wells is roughly parallel to the axis of the Middlebourne syncline. This data would tend to strengthen the assumption that this interval is fairly constant along the axis of this trough, as above outlined.

On the west flank of the northeast end of this trough appears a terrace or flat with a slight rise to the west. The writer has termed this the **Elk Fork terrace** from the stream of that name flowing westward across the same, and from which the famous "Elk Fork" oil field was named. The towns of Middlebourne, Kidwell, Sandusky and Polard are all located over this structure terrace.

The Wick Anticline. The next fold or arch in the rocks to the west of the Middlebourne syncline in Tyler county is the Wick anticline which the writer has named from the town of Wick on the west flank of the arch. The most con-

spicuous feature of this fold is what appears to be a dome just east from Bowles Mills where the Pittsburg coal horizon is thrown up to over 400′ A. T. This dome appears to die down in every direction except to the south where it sends off the spur termed the Wick anticline which crosses Sugar creek about one-half mile east of Wick, veers to the southwest and dies down within two miles. Just east of Wick it throws the Pittsburg coal seam up to over 350′ A. T.

The Shiloh Syncline. The structural basin next on the west of the Wick anticline in Tyler county is called the Shiloh syncline by the writer from the town of that name just east of the point where it passes into Pleasants county. Its northeast end appears to be on the north side of Pursley creek, two miles east of Pursley where the A. Heinzman No. 1 well (T. 34) shows the top of the Pittsburg coal as low as 290′ A. T. From this point the axis of the trough appears to take an almost due southwest course, crossing Middle Island creek one-fourth mile above the mouth of Shrivers run, and also near the mouth of Buffalo. It intersects the Tyler-Pleasants county line one mile northwest of Shiloh. The Pittsburg coal was also noted in the log of the E. J. Osborne No. 1 (T. 61) well at Shiloh. The average interval (1180-1185 feet) from the top of the Pittsburg coal to the top of the Big Injun Sand in the Heinzman and Osborne wells (T. 34 and T. 61) was used in determining the position of the key rock in other wells along this trough between Luzon and Shiloh. The famous salt water well on the Joseph Archer farm (T. 68) is located near the axis of this syncline.

The Sistersville Anticline. The next structural arch to the west of the Shiloh syncline in Tyler county is the Sistersville anticline. It is named by the writer from the town of Sistersville on the west flank of the arch. The axis of this fold of the rocks appears to enter Tyler county from the Ohio side about one mile above Sistersville where it has a southeast course to a point about three-fourths of a mile east of the town, where it takes a southwest course roughly parallel with the river for about four miles to a point one mile and

a quarter northeast of Matamoras station where it swerves more to the west and again reaches the Ohio river near Matamoras station. The Pittsburg coal seam is thrown up to over 450′ A. T. at points along the crest of this arch. The writer was able to obtain only four or five detailed records in which the Pittsburg coal was noted from the hundreds of wells drilled in the Sistersville field, the logs of many of the wells only calling for the depth to the tops of the Keener Sand and the Big Injun Sand, and some giving only the depth to the oil pay. Some of the records failed to note or discriminate the Keener Sand when the Big Injun Sand was called for. It thus makes it quite difficult to determine the exact location of the axis of this fold, but it is believed that the above outlined location is a close approximation. In the several well records in this field where only the top of the Big Injun Sand was called for, the writer took 1180 feet as the proper interval from the top of the Big Injun Sand up to the top of the Pittsburg coal to determine the latter's horizon in these wells. This is the average interval in the following wells in which the Pittsburg seam was noted in their logs: Roome-Iseman No. 8 (T. 11-A), J. T. Leasure No. 3 (T. 14-A) and Anchutz No. 12 (T. 39) in the Sistersville field, and Adam Williamson No. — (T. 43) at Friendly.

CHAPTER IV.

GENERAL GEOLOGY OF THE MARSHALL-WETZEL-TYLER AREA.

INTRODUCTION.

Geologists have classified the rocks of the earth's surface into divisions based mostly on animal and vegetable life of the past ages as revealed by fossils preserved in the rocks themselves.

The principal divisions of the geologic column, constructed on this basis, are as follows:

Cenozoic—Recent life forms.

Mesozoic—Less recent forms.

Paleozoic—Oldest forms of life.

Archaean—Generally crystalline rocks with fossils and direct evidence of life, largely destroyed.

The rocks which crop to the surface in West Virginia are mostly included in the Paleozoic division and the greater portion of the area of the State consists of rocks belonging to one subdivision of this era, the Carboniferous.

The subdivisions or ages of the Paleozoic are:

Carboniferous { Upper { Permian / Coal Measures or Pennsylvanian. / Lower, Subcarboniferous or Mississippian.

Devonian.

Silurian.

Ordovician.

Cambrian.

The stratified rocks of the Marshall-Wetzel-Tyler area are included wholly in the Upper Carboniferous, and the exposed beds are all above the Allegheny Series. The following table illustrates the subdivisions of the Upper Carboniferous as found in northern West Virginia:

TABLE OF GEOLOGICAL FORMATIONS IN WEST VIRGINIA.

UPPER CARBONIFEROUS.

Dunkard, or Permo-Carboniferous series (1100 to 1200 ft.)

Monongahela Series (260 to 400 feet.)

Conemaugh Series (500 to 600 feet)

Allehgeny Series (225-350 feet)

Upper Freeport Coal.
Upper Freeport Limestone.
Boliver Fire-clay.
Upper Freeport Sandstone.
Lower Freeport Coal.
Lower Freeport Limestone.
Lower Freeport Sandstone.
Upper Kittanning Coal.
Middle Kittanning Coal.
Lower Kittanning Coal.
Lower Kittanning Clay.
Lower Kittanning Sandstone.
Vanport (Ferriferous) Limestone.
Clarion Sandstone.
Clarion Coal.
Clarion Clay.

Pottsville Series (Northern Section, 250-300 feet)

Homewood Sandstone.
Mt. Savage Fire-clay.

Mt. Savage Coal.
Upper Mercer Coal.
Lower Mercer Coal.
Upper Connoquenessing Sandstone.
Quakertown Coal.
Lower Connoquenessing Sandstone.
Sharon Coal.
Sharon Conglomerate.

Lower Carboniferous.

Mauch Chunk Shales (40—250 feet.)
Greenbrier Limestone (15—100 feet.)
Pocono Sandstones (400—600 feet.)

DEVONIAN.

Catskill Sandstones (Venango Oil Group (300—500 feet.)

Chemung and Hamilton Shales, penetrated in Wheeling deep well to a depth of nearly 2,000 feet below the Venango Oil Sand Group without reaching the corniferous Limestone.

Some secions will now be given, illustrating the order and character of the several formations in the Marshall-Wetzel-Tyler area.

MARSHALL-WETZEL- TYLER SECTION.

Section at the mouth of Grandstaff run of Wheeling creek, Sand Hill district, Marshall county, combined with well (8) or Geo. P. Folmar No. 1.

	Thickness Feet	Total Feet		
Concealed from top of hill.....	10.0	10.0		
Limestone	5.2	15.2	93.2′	
Sandstone, concealed and shales	78.0	93.2		
Slaty coal blossom and fire clay, coal horizon	1.2	94.4		
Sandstone, flaggy and rotten..	15.6	110.0		
Shales	23.2	133.2	84.0′	
Limestone, gray and hard, good Middle Washington	8.0	141.2		Dunkard 296.8′ Series.
Sandstone, thin and shales	36.0	177.2		
Coal blossom, heavy, Washington	1.6	178.8		
Concealed, sandstone and shales	14.0	192.8		
Slate, black	1.0	193.8		
Coal, slaty, Little Washington..	0.7	194.5		
Sandstone and shale	8.7	203.2	119.6′	
Limestone, gray	5.2	208.4		
Shales, sandy	20.8	229.2		
Concealed	26.0	255.2		
Shaly blossom, dark	0.0	255.2		
Concealed	41.6	296.8		
Coal blossom, Waynesburg ...	0.0	296.8		
Concealed to top of Folmar Well, (8)	90.2	387.0		
Conductor	17.0	404.0	268.2′	
Slate	40.0	444.0		Monongahela 326.2′ Series.
Unrecorded	121.0	565.0		
Coal, Sewickley, Lower	5.0	570.0		
Unrecorded	47.0	617.0	58.0′	
Coal, Pittsburg	6.0	623.0		

Slate	20.0	643.0	
Limestone	5.0	648.0	
Slate and shell	23.0	671.0	
Limestone	10.0	681.0	
Red rock	5.0	686.0	
Limestone	5.0	691.0	
Red rock	10.0	701.0	
Slaty limestone with gas at bottom (325')	11.0	712.0	
Slate	47.0	759.0	
Red rock	22.0	781.0	
Slate	15.0	796.0	
Limestone	5.0	801.0	
Slate	60.0	861.0	
Limestone	10.0	871.0	
Slate	10.0	881.0	
Red rock	5.0	886.0	Conemaugh 526.' Series.
Slate	22.0	908.0	
Limestone	20.0	928.0	
Slate	4.0	932.0	
Limestone	20.0	952.0	
Sandy Limestone	15.0	967.0	
Red rock	10.0	977.0	
Lime shell	5.0	982.0	
Slate	8.0	990.0	
Red rock	15.0	1005.0	
Slate	7.0	1012.0	
Limestone	30.0	1042.0	
Black slate	30.0	1072.0	
Slate	40.0	1112.0	
Lime Shell	5.0	1117.0	
Slate	7.0	1124.0	
Limestone	5.0	1129.0	
Slate	20.0	1149.0	
Limestone	17.0	1166.0	
Slate	21.0	1187.0	
Limestone	21.0	1208.0	
Limestone	15.0	1223.0	
Slate	10.0	1233.0	
Limestone	5.0	1238.0	
Slate	10.0	1248.0	
Lime shell	4.0	1252.0	Allegheny 283.' Series.
Lime, gritty	20.0	1272.0	
Slate	20.0	1292.0	
Coal, Lower Freeport	3.0	1295.0	
Slate	15.0	1310.0	
Sandy limestone	10.0	1320.0	
Sandstone, hard "**2nd Cow Run**"	52.0	1372.0	
Unrecorded	5.0	1377.0	
Black slate	55.0	1432.0	

Salt sand	35.0	1467.0	
Slate	5.0	1472.0	
Sandstone	10.0	1482.0	
Slate	20.0	1502.0	
Sandy lime	7.0	1509.0	Pottsville
Lime shell	9.0	1518.0	219.'
Sandstone (water 1180')	50.0	1568.0	Series.
Sandstone	50.0	1618.0	
Slate	5.0	1623.0	
Sandstone	28.0	1651.0	
Slate	30.0	1681.0	Mauch Chunk
Sandstone, black	6.0	1687.0	40.'
Sandstone	4.0	1691.0	Series
Big Lime	16.0	1707.0	Greenbrier Limestone.
Keener sand	20.0	1727.0	
Big Injun sand	150.0	1877.0	
Slate	70.0	1947.0	
Limestone and shells	4.0	1951.0	
Slate	30.0	1981.0	
Sandstone	6.0	1987.0	
Slate	20.0	2007.0	
Lime shells	7.0	2014.0	
Slate	20.0	2034.0	Pocono
Lime shells	5.0	2039.0	516'
Slate	20.0	2059.0	Series.
Lime shells	5.0	2064.0	
Slate	61.0	2125.0	
Slate	5.0	2130.0	
Limestone	10.0	2140.0	
Slate	42.0	2182.0	
Limestone	20.0	2202.0	
Slate	10.0	2212.0	
Lime shells	11.0	2223.0	
Slate	20.0	2243.0	
Limestone	20.0	2263.0	
Slate	30.0	2293.0	
Limestone	5.0	2298.0	Catskill
Slate	10.0	2308.0	126'
Limestone	5.0	2313.0	Series.
Slate	20.0	2333.0	
Red rock	11.0	2344.0	
Unrecorded	5.0	2349.0	
Depth of well 1962'.			

Another hand-leveled section at Majorsville, at the southeast corner of Sand Hill district, Marshall county, combined with the log of the S. T. Alley No. I gas well, located just below the town, on the north bank of Wheeling creek exhibits the following succession of the strata in that region:

Majorsville Section.

	Thickness Feet	Total Feet		
Unrecorded from top of knob west of town	340.0	340.0	375′	
Limestone, **Middle Washington**	5.0	345.0		
Shales	30.0	375.0		
Coal blossom, Washington, double bedded	10.0	385.0		
Sandstone, concealed and shales	30.0	415.0		Dunkard
Massive sandstone	10.0	425.0		503.3′
Shales	20.0	445.0		Series.
Shale, black	0.9	445.9		
Limestone silicious, and limy shales	5.0	450.9	128.3′	
Sandy shales	10.0	460.9		
Limestone, nodular	0.9	461.8		
Shales, sandy	6.0	467.8		
Sandstone	3.0	470.8		
Shales, sandy with streaks of sandstone	32.0	502.8		
Dark shale, fossil plants, Cassville	0.5	503.3		
Coal, Waynesburg with partings	3.7	507.0		
Shales and sandstone	15.0	522.0		
Limestone, **Waynesburg**	6.0	528.0		
Concealed to top of well (25) on Alley farm No. 1	7.0	535.0	191.7′	
Conductor	16.0	551.0		
Limestone, hard	10.0	561.0		
Limestone, hard	120.0	681.0		
Limestone	4.0	685.0		
Limestone	10.0	695.0		Monongahela
Coal, Upper Sewickley	5.0	700.0		311.7′
Limestone	10.0	710.0		Series.
Slate	5.0	715.0		
Limestone, hard	15.0	730.0		
Slate and shells	10.0	740.0		
Limestone, hard	20.0	760.0	120′	
Slate	10.0	770.0		
Limestone	20.0	790.0		
Slate	19.0	809.0		
Coal, Pittsburg (Steel line)	6.0	815.0		

Limestone, hard	5.0	820.0	
Slate	5.0	825.0	
Slate	10.0	835.0	
Limestone, hard	25.0	860.0	
Slate	5.0	865.0	
Lime	5.0	870.0	
Pink rock	5.0	875.0	
Limestone	10.0	885.0	
Hard shells	5.0	890.0	
Red rock (cave)	15.0	905.0	
Red rock, hard	10.0	915.0	
Slate	5.0	920.0	
Limestone, hard	10.0	930.0	
Slate	20.0	950.0	Conemaugh
Red rock	15.0	965.0	525′
Slate	40.0	1005.0	Series.
Slate	30.0	1035.0	
Red rock	38.0	1073.0	
Slate	22.0	1095.0	
Shells	30.0	1125.0	
Slate, limy	20.0	1145.0	
Shells	5.0	1150.0	
Slate	15.0	1165.0	
Red rock	15.0	1180.0	
Slate	30.0	1210.0	
Pink rock	10.0	1220.0	
Limy shells	15.0	1235.0	
Slate	35.0	1270.0	
Sand, white, bottom Dunkard (Upper Mahoning)	70.0	1340.0	
Slate	5.0	1345.0	
Sand	30.0	1375.0	
Slate	27.0	1402.0	
Coal, Lower Freeport, little gas	3.0	1405.0	
Slate	5.0	1410.0	Allegheny
Sand, dark "2nd Cow Run"	115.0	1525.0	270′
Slate	30.0	1555.0	Series.
Sandstone, black	15.0	1570.0	
Slate, dark	15.0	1585.0	
Hard shell	5.0	1590.0	
Sand, dark	20.0	1610.0	
Slate, black	10.0	1620.0	
Slate	15.0	1635.0	
Sand, hard	5.0	1640.0	Pottsville
Slate	15.0	1655.0	205′
Sand	20.0	1675.0	Series
Sand, gas and water bottom	80.0	1755.0	
Sand, white and hard	60.0	1815.0	
Limestone, black	15.0	1830.0	Mauch Chunk
Slate, black	5.0	1835.0	42′
Limestone, black	22.0	1857.0	Series.
Limestone, white	63.0	1920.0	Greenbrier Limestone.
Sand, Big Injun Gas at 1974′	78.0	1998.0	Pocono.

A section measured by aneroid on the head of Boggs run in the northwest corner of Marshall county in conjunction with the log of the Boggs run deep well by the Wheeling Development Company[1], gives the following:

Boggs Run Section, Marshall County.

	Thickness Feet	Total Feet		
Massive sandstone, concealed and shale from top of hill..	120.0	120.0	202′	
Limestone, blue and hard	2.0	122.0		
Concealed and shale	80.0	202.0		
Coal blossom, heavy, Dunkard.	0.0	202.0		
Shale	15.0	217.0		
Massive sandstone to bench ..	25.0	242.0		
Concealed and shale	45.0	287.0	140′	
Sandstone, friable	10.0	297.0		
Concealed, coal blossom, (Wash. "A") and limestone	45.0	342.0		Dunkard 467′ Series.
Sandstone, flaggy	20.0	362.0		
Concealed and shale	15.0	377.0	65′	
Black slate	0.0	377.0		
Concealed and shale	30.0	407.0		
Coal, blossom, heavy, Washington	0.0	407.0		
Concealed to forks of private road ¼ mile above deep well	15.0	422.0	110′	
Concealed to top of deep well..	35.0	457.0		
(Boggs Run Deep Well Log)				
Unrecorded	60.0	517.0		
Unrecorded	215.0	732.0		
Limestone and **coal Sewickley, Lower**	8.0	740.0	Monongahela	
Limestone	32.0	772.0	270′	
Shale, gray	5.0	777.0	Series	
Limestone	4.0	781.0		
Coal, Pittsburg	6.0	787.0		
Gray sandy shale	30.0	817.0		
Sandstone, gray	8.0	825.0		
Greenish, gray slate	12.0	837.0		
Red shale	30.0	867.0	Series	
Red and brown shale	34.0	901.0	530′	
Unrecorded	40.0	941.0	Conemaugh	
Gray sandy shale	6.0	947.0		
Unrecorded	10.0	957.0		
Red shale	250.0	1207.0		
Shale, red, coal, etc.	11.0	1317.0		

1. Vol. I, page 364, W. Va. Geol. Survey.

	Thickness Feet	Total Feet	
Coal, Upper Freeport	4.0	1321.0	Allegheny, Pottsville, 540'
Sandstone, gray	45.0	1366.0	
Sandstone, coarse and gray	83.0	1449.0	Mauch Chunk and Greenbrier Limestone.
Sandstone, fine and white	408.0	1857.0	
Sandstone, coarse and gray	60.0	1917.0	
Sandstone, fine and white	90.0	2007.0	Pocono 500'
Sandstone, white, very hard, (base of **Big Injun Sand**)	20.0	2027.0	
Shale, dark gray	330.0	2357.0	
Gray sandy shale	110.0	2467.0	
Gray and red shale	100.0	2567.0	
Gray and blue shale and sandy beds	350.0	2917.0	
Sandy beds, dark gray	60.0	2977.0	
Gray sandy shells	180.0	3157.0	
Unrecorded	175.0	3332.0	
Light gray shale	80.0	3412.0	
Sandy bed, light gray (slight show of oil)	40.0	3452.0	Catskill Reds, Chemung and 2600' Hamilton Shales or **Devonian.**
Shale, gray and dark	80.0	3532.0	
Gray sandy shale	125.0	3657.0	
Shale, gray	60.0	3717.0	
Shale, dark	80.0	3797.0	
Shale, dark gray	160.0	3957.0	
Shale, light gray	75.0	4032.0	
Shale, gray	375.0	4407.0	
Shale, soft, gray	50.0	4457.0	
Shale, dark, sandy with an occasional shell to bottom	500.0	4957.0	

The following section on Middle Grave Creek down hill road to southwest, 3½ miles southeast of Moundsville, and about 2 miles above mouth of Toms run, was measured by hand level.

Middle Grave Creek Section.

	Ft.	In. Thickness	Ft.	In. Total	
Concealed, sandstone and shale from top of hill	40	0	40	0	
Limestone, brecciated	1	0	41	0	
Concealed	2	0	43	0	
Limestone, brecciated	1	0	44	0	
Sandstone and shales	15	3	59	3	
Limestone, gray and brecciated	1	0	60	3	129' 5"
Shales	25	9	86	0	
Limestone, hard, bluish	1	0	87	0	
Shales	4	2	91	2	
Sandstone, massive, Nineveh	17	3	108	5	
Concealed and shales	21	0	129	5	

	Thickness Ft.	In.	Total Ft.	In.		
Slate, black, Nineveh coal horizon	0	6	129	11		
Shales, sandy	3	1	133	0		
Limestone, blue and hard	1	0	134	0		
Concealed	12	6	146	6		
Shales with limy nuggets at top	10	6	157	0	68′ 2″	
Limestone, silicious	3	0	160	0		
Shales	7	9	167	9		
Shales, dark red	15	4	183	1		
Sandstone, flaggy, Fish Creek	11	6	194	7		
Shales	3	0	197	7		
Coal blossom, Hostetter	0	0	197	7		
Shales	5	0	202	7		
Limestone, friable and brecciated	4	0	206	7	62′ 5″	
Shales, buff	17	3	223	10		
Shales with thin sandstones	36	2	260	0		
Coal, slaty (not well exposed) Dunkard	0	10	260	10		Dunkard 510′ to 515′ Series.
Shales, concealed and massive sandstone	23	9	284	7		
Shales	10	6	295	1		
Limestone, reddish and silicious, Upper Washington	2	0	297	1		
Shales, limy, Upper Washington	2	3	299	4		
Limestone, reddish and silicious, Upper Washington	1	6	300	10	145′ 9″	
Sandstone, massive	31	0	331	10		
Shales and concealed	19	0	350	10		
Limestone, not well exposed Middle Washington	7	9	358	7		
Concealed	25	9	384	4		
Sandstone, flaggy, top friable	5	2	389	6		
Shale and concealed	16	3	405	9		
Coal, slaty....0.6 Shales .....5.2 Slaty blossom, 0.6 } Washington	6	2	411	11	47′ 5″	
Shales	15	6	427	5		
Shales, buff	25	9	453	2		
Slaty blossom, Waynesburg "A" coal horizon	0	0	453	2		
Shales	31	0	484	2		
Sandstone, flaggy	5	3	489	5		
Shales	10	6	499	11		
Limestone, dark, flaggy, **Elm Grove**	2	0	501	11	64′ 10″	
Concealed to forks of road on Middle Grave Creek, where U. S. G. S. is 731 A. T.	16	1	518	0		

The 16′ 1″ of concealed strata at base of section possibly contains the Waynesburg coal and the Dunkard series is here about 510 to 515 feet thick.

A section measured at the mouth of Grave creek, 1 mile south of Moundsville, and connected with the shaft to the Pittsburg coal seam on the south side of the creek at this point shows as follows:

Moundsville Section.

	Thickness Feet	Total Feet		
Unrecorded from top high knob	130.0	130.0	296′	Dunkard 538′ Series.
Limestone, visible	1.0	131.0		
Concealed, some shale	165.0	296.0		
Slate, black, (6″) (Jollytown Coal)	1.0	297.0		
Shales, limy and limestone, brecciated	10.0	307.0		
Sandstone, massive and concealed	10.0	317.0	121′	
Sandstone, friable, Marietta	50.0	367.0		
Limestone, dark, silicious top gray, and hard bottom **(middle Wash.)**	32.0	399.0		
Shales, dark, limy	8.0	407.0		
Shales, dark and limy	10.0	417.0		
Coal 2′ 6″ / **Shales, dark** 0′ 9″ / **Coal, slaty** 0′ 7″ — **Washington** 3′ 10″	4.0	421.0		
Shales and concealed	13.0	434.0		
Sandstone and shale	30.0	464.0		
Concealed	30.0	494.0	121′	
Shales and flaggy sandstone	25.0	519.0		
Limestone, dark blue and hard (6″)	1.0	520.0		
Shales	10.0	530.0		
Limestone, **Elm Grove**	4.0	534.0		
Shales, dark	4.0	538.0		
Coal 0′ 2″ / **Slate** 0′ 1″ / **Coal** 1′ 8″ — **Waynesburg** 1′ 11″	2.0	540.0		
Shale	5.0	545.0	Monongahela 295′ Series.	
Sandstone and concealed to top of Panama Coal Mining Company's Shaft	100.0	645.0		
Unrecorded in shaft	180.0	825.0		
Coal, Pittsburg, with partings	8.0	833.0		

Another section measured by aneroid down hill road from Rosbys Rock, Marshall county, and connected with the old Rosbys Rock Well (see Vol. 1-(a) page 223), ¼ mile west of the town, gives the following:

Rosbys Rock Section, Marshall County.

	Thickness Feet	Total Feet		
Concealed, shale, thin sandstones and concealed from top knob	40.0	40.0		
Sandstone, flaggy	5.0	45.0		
Shale and concealed with limestone boulders 15' below top	63.0	108.0	108'	
Shale, black, bituminous (4"), Windy Gap Coal	0.0	108.0		
Limestone, **Windy Gap**	2.0	110.0		
Concealed	10.0	120.0		
Sandy shale	10.0	130.0		
Concealed to forks of road	20.0	150.0		
Limestone, nodular, (thickness not exposed)	0.0	150.0		
Concealed	40.0	190.0		
Limestone (in situ?)	1.0	191.0	288'	
Concealed	10.0	201.0		
Sandstone, friable	20.0	221.0		
Concealed	55.0	276.0		
Sandstone, flaggy	5.0	281.0		
Concealed and shale	60.0	341.0		
Sandstone, massive	15.0	356.0		
Red shale	5.0	361.0		
Sandstone, massive	15.0	376.0		
Shale	10.0	386.0		
Sandstone, massive	7.0	393.0		
Shale, dark at bottom	3.0	396.0		
Coal, slaty (5"), Jollytown	0.0	396.0		
Shale	20.0	416.0		
Concealed	25.0	441.0		Dunkard 741' Series.
Sandstone, massive, friable at top	30.0	471.0		
Concealed	25.0	496.0		
Shale, red and buff	15.0	511.0		
Sandstone, massive, friable at top	26.0	537.0	225'	
Shale	8.0	545.0		
Limestone, flaggy and silicious	1.0	546.0		
Concealed and shale	13.0	559.0		
Limestone, hard and gray, Middle Washington	2.0	561.0		
Sandstone and shale	10.0	571.0		
Concealed	25.0	596.0		
Sandstone, massive, **Marietta**	25.0	621.0		
Black slate 6' 3" } **Wash'gton** 1' 10" **Coal, slaty,** 1' 7"	2.0	623.0		
Fire clay	1.0	624.0	50'	
Sandstone, flaggy	6.0	630.0		
Sandy shale, with **fossil plants**	5.0	635.0		

	Thickness Feet	Total Feet	
Coal, slaty, Little Washington (9″)	1.0	636.0	
Shale	15.0	651.0	
Concealed	20.0	671.0	
Coal, slaty, Waynesburg "A" (5″)	0.0	671.0	
Concealed to top of Rosbys Rock Well	10.0	681.0	
(Rosbys Rock) Well record top 770 A. T.			70′
Unrecorded	60.0	741.0	
Unrecorded	212.0	953.0.	
Coal, Sewickley, (thick., not given)	0.0	953.0	Monongahela 290′ Series.
Unrecorded	78.0	1031.0	
Coal, Pittsburg (thick., not given)	0.0	1031.0	
Unrecorded	530.0	1561.0	Conemaugh and
Dunkard Sand	0.0	1561.0	715′
Unrecorded	185.0	1746.0	Allegheny Series.
Salt Sand (salt water 1915)	311.0	2057.0	Pottsville Series.
Unrecorded	49.0	2106.0	Mauch Chunk.
Big Lime	0.0	2106.0	
Unrecorded	50.0	2156.0	Greenbrier Limestone.
Bib Injun Sand, gas in Salt water 2213 and 2221	195.0	2351.0	Pocono
Unrecorded	460.0	2811.0	
Gantz Sand	0.0	2811.0	Upper Devonian
Unrecorded, shells and slate	790.0	3601.0	

A section on Fish Creek, measured by hand level north down the hill road to the mouth of Lynn Camp run and joined with the log of the Isaac Crow well No. 2 (M 49) at mouth of Upper Bowman, exhibits the following succession of strata:

Lynn Camp Section, Marshall County.

	Thickness Feet	Total Feet	
1. Concealed from top of knob to forks of road	60.0	60.0	
2. Concealed with shale and sandstone	117.0	177.0	213.4′
3. Red shale	10.4	187.4	
4. Limy shale and concealed	26.0	213.4	
5. **Limestone,** interstratified with sandy shale	28.0	241.4	
6. Concealed	10.4	251.8	
7. Concealed, sandstone and concealed	26.0	277.8	139.8′
8. Sandstone, massive	10.4	288.2	
9. Concealed	40.6	328.8	
10. Sandstone, friable	15.6	344.4	
11. Sandy shale	8.8	353.2	

		Thickness Feet	Total Feet		
12.	**Limestone, silicious and brecciated Nineveh**	3.0	356.2		
13.	Sandstone, friable	9.0	365.2		
14.	Shale	5.2	370.4		
15.	Concealed	26.0	396.4		
16.	Red shale	10.4	406.8		
17.	Concealed	10.4	417.2		
18.	Sandstone, friable	26.0	443.2	173.2′	
19.	Concealed	20.8	464.0		
20.	Sandstone and concealed	8.6	472.6		
21.	Sandstone, massive	7.0	479.6		
22.	Concealed and sandstone	15.6	495.2		
23.	Massive sandstone, Dunkard	31.2	526.4		
24.	**Coal blossom, Jollytown**	0.0	526.4		
25.	Concealed	46.8	573.2		Dunkard 789′ Series.
26.	Sandstone, massive	25.4	598.6		
27.	Concealed	30.0	628.6		
28.	**Limestone, Middle Washton**	7.0	635.6	141.9′	
29.	Concealed	17.1	652.7		
30	**Coal blossom, trace**	0.0	652.7		
31.	Shale, flaggy sandstone and shale	15.6	668.3		
32.	Slate, black, 0.4′				
33.	Coal, 1.0′ — **Washington**				
34.	Slate, black, 2.0′ —				
35.	Coal, 0.2′ — 4.9′				
36.	Slate, black, 0.2′ — **Coal**			65.5′	
37.	Coal, 1.1′	4.9	673.2		
38.	Concealed	38.2	711.4		
39.	Sandstone, friable and shale	22.4	733.8		
40	Coal, 0.1′				
41.	Shale, dark fossil plants 0.7′ — **Waynesburg "A"**				
42.	Coal 0.1′ —				
43.	Shale, dark, soft 0.5′ — **Coal**				
44.	Shale, gray, 0.7′ — 4.6′				
45.	Slate, black, 0.5′				
46.	Coal, slaty, 2.0′	4.6	738.4	64.2′	
47.	Fire clay and shale	2.6	741.0		
48.	Limestone, visible	1.0	742.0		
49.	Concealed to creek level at mouth of Lynn Camp (Isaac Crow No. 2 Record. Base of Washington coal flush with top of hole).	12.0	754.0		
50.	Unrecorded	44.0	798.0		

		Thickness Feet	Total Feet	
51.	**Coal, Waynesburg horizon** (Supplied by writer.)	0.0	798.0	
52.	Unrecorded	201.0	999.0	Monongahela 295′
53.	**Coal, Sewickley**	5.0	1004.0	Series.
54.	Unrecorded	85.0	1089.0	
55.	**Coal, Pittsburg**	4.0	1093.0	
56.	Unrecorded	480.0	1573.0	Conemaugh
57.	Dunkard Sand (Mahoning)	40.0	1613.0	520′ Series.
58.	Unrecorded	541.0	2154.0	Allegheny & Pottsville
59.	Big Lime	60.0	2214.0	Greenbrier Limestone.
60.	**Big Injun Sand**	240.0	2454.0	Pocono
61.	Unrecorded	398.0	2852.0	
62.	Lime	60.0	2912.0	
63.	**Red Rock**	60.0	2972.0	
64.	Lime	30.0	3002.0	Catskill
65.	Unrecorded	30.0	3032.0	635′
66.	**Gordon Stray Sand**	00.0	3032.0	Series.
67.	Unrecorded	40.0	3072.0	
68.	**Gordon Sand**	17.0	3089.0	

In the above section Nos. 38-50 are really in the top portion of the Crow well record, but in writing section only Nos. 50-68 were taken from the log of the well, Nos. 1-49 inclusive being measured from exposed strata.

Another section on the Ohio river front, measured by hand level and aneroid down the hill southeast of Cresap Station, and joined to the log of a core test on the T. B. McFarland farm at the mouth of Graveyard run, exhibits the following succession of strata:

Powhatan Station Section, Marshall County.

	Thickness Feet	Total Feet	
(Nos. 1—17 measured by aneroid)			
1. Sandstone, coarse, rotten, capping hill	35.0	35.0	60′
2. Red shale with thin sandstones	25.0	60.0	

	Thickness Feet	Total Feet		
3 **Shale, black (3″) Hostetter coal?**	00.0	60.0		
4. Fire clay, reds and concealed to forks of road	25.0	85.0		
5. Concealed and shale	15.0	100.0		
6. Sandstone	10.0	110.0		
7. Shale and concealed	15.0	125.0		
8. Sandstone	5.0	130.0		
9. Concealed	20.0	150.0	189′	
10. Sandy shale and thin sandstones	25.0	175.0		
11. Sandstone	15.0	190.0		
12. Shale and concealed	45.0	235.0		
13. Sandstone, flaggy and friable	10.0	245.0		
14. Concealed and shale	4.0	249.0		Dunkard 440.3′ Series.
15. **Coal, good (10″), Washington "A"**	1.0	250.0		
16. Shale and concealed	5.0	255.0		
17. Sandstone, massive	30.0	285.0		
(Nos. 18-43 measured by hand level)				
18. Concealed and sandstone flaggy	15.4	300.4	87.7	
19. Concealed, with **limestone boulders**	9.3	309.7		
20. **Limestone, dark gray, flaggy**	1.0	310.7		
21. Sandy shale and concealed	15.4	326.1		
22. Black slate and concealed	10.6	336.7		
23. **Coal blossom, heavy, Washington**	00.0	336.7		
24. Shales, yellow and gray	10.0	346.7		
25. Concealed	5.0	351.7		
26. Sandstone, massive, Mannington, with shale in middle	25.7	377.4	110.9′	
27 Concealed	41.2	418.6		
28. Sandstone, with two feet of shale in middle	6.0	424.6		
29. Concealed	15.0	439.6		
30. **Limestone, gray and hard, Elm Grove**	00.7	440.3		
31. Concealed and gray shale	7.3	447.6		

	Thickness Feet	Total Feet		
32. **Shale, black, .4'** } Waynesburg ..	0.7	448.3		
33. **Coal, .3'** } Coal				
34. Sandstone, and sandy shale	18.4	466.7		
35. Concealed	10.0	476.7		
36. **Coal blossom, trace, Little Waynesburg**	0.0	476.7		
37. Concealed	5.2	481.9		
38. Flaggy sandstone and sandy shale	10.3	492.2	162.6'	
39. Concealed and sandstone.	10.3	502.5		
40. Concealed with 18" Limestone at bottom	51.5	554.0		
41. Concealed	41.2	595.2		
42. Limestone	5.0	600.2		
43. Concealed to top of McFarland boring	10.0	610.2		
(Nos. 44-54, McFarland Boring Record 635 AT)				Monongahela 262.9' Series.
44. Gravel and limestone boulders	30.0	640.2		
45. Limestone	8.0	648.2	71.0'	
46. Limestone	26.0	674.2		
47. Limestone	7.0	681.2		
48. **Coal Redstone**	2.5	683.7		
49. Sandstone	3.0	686.7		
50. Limestone	11.0	697.7	29.3'	
51. Dark shale	5.0	702.7		
52. **Coal, Pittsburg (7' 10")**.	7.8	710.5		
53. Fire clay	0.7	711.2		Conemaugh Series.
54. Limestone shale to bottom hole	1.0	712.2		

Another section measured by aneroid down the Roberts Ridge hill road to the mouth of Big Tribble creek and joined to the log of the Nellie (Eugene) Workman boring at the mouth of Little Tribble creek, 1 mile due east of Graysville, Marshall County, shows the following succession of strata:

Graysville Section, Marshall County.

	Thickness Feet	Total Feet	
Concealed from top of hill in road	30.0	30.0	
Sandstone, massive, gray, coarse, **Nineveh**	45.0	75.0	119'
Concealed, massive sandstone a concealed	44.0	119.0	

	Thickness Feet	Total Feet		
Limestone, blue and hard, Nineveh	1.0	120.0		
Shales and concealed	60.0	180.0	161′	
Sandstone, concealed and massive sandstone	80.0	260.0		
Concealed	20.0	280.0		
Coal, slaty (4″), Jollytown	0.0	280.0		Dunkard, 527.2′ Series.
Concealed	25.0	305.0		
Sandstone, massive	30.0	335.0		
Shale	9.0	344.0	130′	
Limestone, yellowish	1.0	345.0		
Shales and concealed	25.0	370.0		
Limestone, Middle Washington.	15.0	385.0		
Concealed	15.0	400.0		
Sandstone, friable	10.0	410.0		
Concealed (**Should contain Wash. coal**)	20.0	430.0		
Limestone, brecciated	5.0	435.0	117.2′	
Sandstone, flaggy	10.0	445.0		
Concealed	65.0	510.0		
Sandstone and shale	10.0	520.0		
Concealed	7.2	527.2		
Concealed	31.8	559.0		
Limestone, gray	1.0	560.0		
Concealed to top of Workman[2] boring	15.0	575.0		
(Top, 635 B. A T.)				
Surface	17.0	592.0		
Sand, shale and gravel	9.0	601.0		
Red shale	5.0	606.0		
Sand shale	3.0	609.0		
Limestone	2.0	611.0		
Blue shale	5.0	616.0		
Limestone	9.0	625.0		
Limestone, with shale partings	10.0	635.0		
Limestone shale	5.0	640.0		
Soft shale	2.0	642.0	191.8′	
Red shale	1.0	643.0		
Sand shale	2.0	645.0		
Limestone shale	5.0	650.0		
Soft shale	2.0	652.0		
Limestone	3.0	655.0		
Sandstone	4.5	659.5		
Shale	3.0	662.5		
Lime shale	11.5	674.0		
Limestone	10.0	684.0		
Green shale	1.0	685.0		
Sand shale	3.0	688.0		
Limestone	5.0	693.0		Monongahela 290′ Series.
Lime and shale mixed	13.0	706.0		
Limestone	7.0	713.0		
Limestone and shale mixed	4.5	717.5		
Shale	1.5	719.0		

2. See Vol. II, page 135 W. Va. Geol. Sur.

	Thickness Feet	Total Feet	
Coal, Sewickley	3.5	722.5	
Sandstone	8.0	730.5	
Limestone	33.5	764.0	
Sand shale	3.0	767.0	
Limestone	4.0	771.0	64.3′
Blue shale	5.0	776.0	
Limestone	3.0	779.0	
Hard shale (16″)	1.3	780.3	
Blue shale	3.0	783.3	
Coal, Redstone (14″)	1.2	784.5	
Shale	8.3	792.8	
Limestone and shale mixed	7.0	799.8	33.9′
Black shale (11′ 10″)	11.8	811.6	
Coal, Pittsburg, (5′ 7″)	5.6	817.2	

The C. Higgs core test at Franklin Station, Marshall county combined with a section measured by hand level and aneroid down the hill road to the northwest showed the following succession of strata:

Franklin Station Section, Marshall County.

	Thickness Feet	Total Feet	
(Nos. 1-6 measured by aneroid)			
1. Massive sandstone, capping knob	15.0	15.0	22′
2. Shale	7.0	22.0	
3. **Limestone, blue and hard.**	3.0	25.0	53′
4. Limy shale, reds and concealed	50.0	75.0	
5. **Limestone boulders, Nineveh?**	25.0	100.0	
6. Concealed	45.0	145.0	111.2′
(Nos. 7-43 measured by hand level to top of core test)			
7. Sandstone and concealed.	41.2	186.2	
8. **Limestone, gray**	1.0	187.2	
9. Sandstone and shale	20.0	207.2	
10. Concealed and reds	67.0	274.2	108′
11. Shales sandy, with thin sandstones	20.0	294.2	

	Thickness Feet	Total Feet		
12. Limestone, silicious at top Upper Washington	3.0	297.2		
13. Shales, red, limy and variegated	15.0	312.2		
14. Sandstone, massive	25.7	337.9		
15. Shales, sandy	20.6	358.5		
16. Concealed	15.5	374.0		
17. Red shale	15.5	389.5		
18. Variegated and sandy shale	20.6	410.1	198.8'	
19. Sandstone, massive, Marietta	10.3	420.4		Dunkard, 590.8' Series.
20. Shales, sandy and variegated	30.9	451.3		
21. Limestone, yellowish, gray on **fracture, Middle Washington**	15.0	466.3		
22. Shales, dark and limy	1.0	467.3		
23. Shales and sandstone	15.4	482.7		
24. Shales, sandy at top	10.3	493.0		
25. Coal, hard, blocky 0′ 6″				
26. Slate, gray 0′ 1″ **Washington Coal**				
27. Coal, hard 3′ 0″				
28. Coal, slaty 0′ 6″				
29. Coal, hard 1′ 5″	5.5	498.5	58′	
30. Concealed	26.7	525.2		
31. Sandstone, massive, friable, **Mannington**	15.5	540.7		
32. Shales, sandy	10.3	551.0		
33. **Coal, Waynesburg "A"**	2.5	553.5		
34. Limy shale and concealed	15.5	569.0		
35. Shales	10.3	579.3	39.8′	
36. Sandy shales	5.0	584.3		
37. Slate, black	0.5	584.8		
38. Sandy shales	6.0	590.8		
39. **Coal blossom, Waynesburg**	1.0	591.8		
40. Concealed	5.0	596.8		
41. Shales	5.3	602.1		
42. **Massive** sandstone, **Gilboy**	25.7	627.8		
43. Concealed, shales and concealed to top of C. Higgs boring (Vol. II, p. 134)	30.9	658.7		
(Boring record Nos. 44-72.) (Top 660 B. A. T.)				
44. Surface	20.0	678.7		
45 Shale	3.0	681.7		
46. Limestone and shale	9.0	690.7	197.9′	
47. Limestone	17.0	707.7		
48. Shale	7.0	714.7		
49. Limestone	1.0	715.7		
50. Shale	1.0	716.7		
51. Limestone	37.0	753.7		

		Thickness Feet	Total Feet		
52.	Lime and shale	3.0	756.7		
53.	Limestone	12.0	768.7		
54.	Limestone shale	8.0	776.7		
55.	Limestone	9.0	785.7		Monongahela 292.9′ Series.
56.	Shale	3.0	788.7		
57.	**Coal, Sewickley, Lower...**	3.5	792.2		
58.	Soft shale	1.5	793.7		
59.	Sandstone	5.0	798.7		
60.	Shale and lime.....	17.0	815.7		
61.	Limestone	6.5	822.2		
62.	Sandstone	13.5	835.7		
63.	Limestone	6.0	841.7		
64.	Lime and sandstone.....	3.0	844.7	95′	
65.	Sand shale	11.0	855.7		
66.	Shale	1.0	856.7		
67.	Limestone	10.0	866.7		
68.	Lime and shale	2.0	868.7		
69.	Shale	7.0	875.7		
70.	Coal "roof" 2′ 0″				
71.	Slate .... 0′ 6″. **Pittsburg coal**	7.7	883.7		
72.	Coal ..... 5′ 3″				

A section measured by aneroid and hand-level in the southwest corner of Marshall county and joined with the Abersold boring record[3] gives the following succession of strata:

Section, Two Miles Southeast of Clarington Station.

		Thickness Feet	Total Feet	
(Nos. 1-3 measured by aneroid).				
1.	Red, limy shale on top hill	5.0	5.0	55′
2.	Concealed and shale....	50.0	55.0	
3.	**Shale, dark, bituminous (Nineveh coal)**	1.0	56.0	
4.	Concealed	14.0	70.0	
5.	Sandstone, massive.....	10.0	80.0	30′
6.	**Fire clay, dark at top, gray at bottom**.....	1.0	81.0	
7.	Shale	4.0	85.0	
8.	**Limestone, silicious, Nineveh**	10.0	95.0	
9.	Buff shale	5.0	100.0	
10.	Flaggy sandstone	20.0	120.0	
11.	Concealed and massive sandstone	25.0	145.0	170′
12.	Shale, red and variegated	15.0	160.0	
13.	Sandstone, massive.....	15.0	175.0	
14.	Limestone, silicious.....	1.0	176.0	
15.	Limy shale and concealed	24.0	200.0	
16.	Sandstone	10.0	210.0	
17.	Buff and variegated shale	45.0	255.0	

3. Vol. II, page 132 W. Va. Geol. Sur.

	Thickness Feet	Total Feet		
18. **Dark shaly fire clay, Jollytown coal**	1.0	256.0		
19. Shale	19.0	275.0		
20. Sandstone, massive	4.0	279.0		
21. Shale, variegated and red	11.0	290.0		Dunkard, 558.9' Series.
22. Sandstone and shale	25.0	315.0		
23. Concealed	20.0	335.0		
24. Red and sandy shale	20.0	355.0		
25. Sandstone, massive, friable at bottom	25.0	380.0	190'	
26 Shale and sandstone friable	15.0	395.0		
27. Shale	5.0	400.0		
28. Fire clay	1.0	401.0		
29. Limestone, gray and hard, **Middle Washington**	1.0	402.0		
30. Concealed	23.0	425.0		
31. Limy beds, sandy shale and sandstone friable	20.0	445.0		
(Nos. 32-35 by hand level)				
32. **Coal, slaty, 3' 0") Washington coal**	4.5	449.5		
33. **Coal, good, 1' 6")** (780L-A. T.)				
34 Fire clay, concealed and sandstone	27.0	476.5		
35. Concealed to top of Abersold boring (M112) (688L-A.T.)	64.4	540.9	113.9'	
(Abersold Boring Record, Nos. 36-94).				
36. Surface	6.0	546.9		
37. Sand and gravel	12.0	558.9		
38. **Waynesburg coal horizon, supplied,**	0.0	558.9		
39. Clay	3.0	561.9		
40. Clay and gravel	7.0	568.9		
41. Sandstone	4.0	572.9	59.0'	
42. Sand shale	17.0	589.9		
43. Red shale	14.0	603.9		
44. Sand shale	12.0	615.9		
45. Blue shale	2.0	617.9		
46. **Coal, Uniontown** (9")	0.8	618.7		
47. Blue shale	5.2	623.9		
48. Sand shale	15.0	638.9		
49. Sandstone	2.0	640.9		
50. Sand shale	3.0	643.9		
51. Red shale	2.0	645.9		
52. Blue shale	3.0	648.9		
53. Lime shale	4.0	652.9		
54. Soft shale	2.0	654.9		

Plate V.—Ohio River Bottom Land on the Southeast Corner of Marshall County, North From Proctor.

		Thickness Feet	Total Feet		
55.	Limestone	4.0	658.9		
56.	Red shale	1.0	659.9		
57.	Limestone	4.0	663.9		
58.	Lime shale	12.0	675.9		
59.	Mixed shale	2.0	677.9		
60.	Red shale	4.0	681.9		
61.	Sand shale	3.0	684.9		
62.	Mixed shale	2.0	686.9		
63.	Limestone	10.0	696.9		
64.	Blue shale	4.0	700.9		
65.	Red shale	1.0	701.9		
66.	Blue shale	2.0	703.9	149.3′	
67.	Limestone	10.0	713.9		
68.	Lime shale	5.0	718.9		
69.	Limestone	5.0	723.9		Monongahela 298.8′ Series.
70.	Light blue shale	3.0	726.9		
71.	Limestone	17.0	743.9		
72.	Shale and limestone	7.0	750.9		
73.	**Limestone**	5.0	755.9		
74.	Shale and Limestone	6.0	761.9		
75.	Blue shale	1.0	762.9		
76.	Soft shale	2.0	764.9		
77.	**Coal,** 1′ 8″ ⎫ **Sewickley**				
78.	Bone coal. 0′ 8″ ⎭ **Lower**	2.3	767.2		
79.	Sandstone	3.7	770.9		
80.	Limestone, with streaks of shale	11.5	782.4		
81.	Shale	4.5	786.9		
82.	Limestone	6.5	793.4		
83	Lime shale	2.5	795.9		
84.	Limestone	3.0	798.9	59.9′	
85.	Lime shale	4.0	802.9		
86.	Sand shale	18.0	820.9		
87.	Sandstone	4.0	824.9		
88.	Blue shale	2.2	827.1		
89.	**Coal, Redstone**	1.1	828.2		
90.	Blue shale	2.8	831.0		
91.	Limestone	14.0	845.0		
92.	Blue shale	4.0	849.0	30.6′	
93.	**Soft shale**	2.8	851.8		
94.	**Coal, Pittsburg** (5′ 11″)	5.9	857.7		

A section measured by aneroid, 1 mile below Marion, down the hill road to southwest, on Proctor creek and joined to the log of the J. W. O'Neil No. 1 well (W 285) shows as follows:

Proctor Creek Section, Marion, Wetzel County.

(Aneroid measurements, checking closely with U. S. G. S. levels)

	Thickness Feet	Total Feet		
Sandy beds and sandstone....	15.0	15.0		
Red shale.....	5.0	20.0		
Shales, sandy top, red bottom..	25.0	45.0		
Sandstone	10.0	55.0		
Shales, red and variegated....	15.0	70.0	135′	
Sandstone	5.0	75.0		
Red shale	15.0	90.0		
Shales, limy, dark red at top..	5.0	95.0		
Concealed	40.0	135.0		
Limestone (6″).....	0.0	135.0		
Concealed	15.0	150.0	112′	
Concealed mostly with some reds	97.0	247.0		
Limestone, blue and hard, Nineveh	3.0	250.0		Dunkard, 780′ Series.
Concealed	70.0	320.0		
Sandstone, massive, Fish Creek	45.0	365.0	220′	
Concealed to bench.....	95.0	460.0		
Massive sandstone and shales..25.0		485.0		
Fire clay, trace, Jollytown coal	0.0	485.0		
Shales	5.0	490.0		
Sandstone, massive.....	30.0	520.0	1′	
Concealed	59.0	579.0		
Fire clay (12″), **Washington "A" Coal horizon**	1.0	580.0		
Concealed	29.0	609.0	87′	
Limestone, dark and flaggy...	1.0	610.0		
Concealed	56.0	666.0		
Coal, Washington to top of J. W. O'Neil, No. 1 gas well.. (J. W. O'Neil No. 1 Record)	4.0	670.0	114′	
Unrecorded in gas well.....	110.0	780.0		
Unrecorded in gas well.....	90.0	870.0		
Coal, Uniontown, (Thickness not given)	0.0	870.0		
Unrecorded	115.0	985.0	205′	
Coal, Sewickley (thick. not given)	0.0	985.0		Monongahela 295′ Series
Unrecorded	90.0	1075.0		
Coal, Pittsburg (thickness not given)	0.0	1075.0		
Unrecorded	160.0	1235.0		
Sand, Murphytown (**Morgantown**)	0.0	1235.0		Conemaugh Allegheny, 1068′ Pottsville and Mauch Chunk
Unrecorded	908.0	2143.0		

	Thickness Feet	Total Feet	
Big lime	75.0	2218.0	Greenbrier Limestone
Big Injun sand	308.0	2526.0	Pocono
Unrecorded	556.0	3082.0	Catskill
Gordon sand	5.0	3087.0	756′
Unrecorded to bottom of well	195.0	3282.0	

Remarks: Water at 2530′; dry in Gordon Sand and no Fifth Sand.

A section measured by aneroid southwest down the hill road to the mouth of Coal fork of Doolin run and joined to the log of well (W. 302) on Samuel Martin farm gives the following:

Doolin Run Section, 1 Mile East of New Martinsville.

	Thickness Feet	Total Feet	
Concealed and sandstone from top of knob 1420 A. T.	30.0	30.0	
Sandy shale	5.0	35.0	70′
Sandstone, mostly	35.0	70.0	
Concealed	10.0	80.0	
Limestone, gray and hard, (6″)	0.0	80.0	
Limy shale, red	5.0	85.0	
Concealed, sandstone and concealed	20.0	105.0	
Red shale	5.0	110.0	
Shale, buff and variegated with thin sandstones	30.0	140.0	144′
Sandstone, flaggy top, friable bottom	10.0	150.0	
Concealed	20.0	170.0	
Shale, variegated and red	30.0	200.0	
Sandstone, flaggy	10.0	210.0	
Concealed	14.0	224.0	
Limestone, yellow (not all exposed 12″)	1.0	225.0	
Concealed and reds	10.0	235.0	34′
Shale, variegated and sandy	15.0	250.0	
Sandstone, friable and sandy shale	8.0	258.0	
Limestone, gray top, yellow bottom (18″)	2.0	260.0	
Red shale and concealed	20.0	280.0	77′
Sandy and red shale	40.0	320.0	
Sandstone, flaggy	10.0	330.0	
Sandstone shale	5.0	335.0	

	Thickness Feet	Total Feet		
Slate dark (3″ to 4″) Nineveh coal	0.0	335.0		
Limestone, nodular, red at bottom	.5.0	340.0		
Shale, red and limy, gray, top	10.0	350.0		
Sandstone	10.0	360.0		
Shale, limy and red	15.0	375.0		
Sandy shale and sandstone	10.0	385.0		
Dark red shale	20.0	405.0	205′	
Concealed	20.0	425.0		
Variegated shale	5.0	430.0		
Massive sandstone	10.0	440.0		Dunkard,
Concealed	10.0	450.0		854′
Dark red and gray shale	20.0	470.0		Series.
Concealed	20.0	490.0		
Red variegated shale	40.0	530.0		
Sandstone, massive	10.0	540.0		
Fire clay and trace dark limy shale, Jollytown coal, with dark gray limestone	0.0	540.0		
Concealed and red shale	5.0	545.0	80′	
Sandstone, friable	20.0	565.0		
Reds dark	5.0	570.0		
Sandstone, friable top, flaggy bottom	50.0	620.0		
Concealed and shale	15.0	635.0		
Massive sandstone, with friable layers	45.0	680.0		
Red shale	5.0	685.0		
Buff sandy shale	20.0	705.0	112′	
Dark shale	5.0	710.0		
Coal (3″), Washington "A"	0.0	710.0		
Limestone, nuggets and limy shale	22.0	732.0		
Coal, slaty 1′ 8″ / Slate, gray 0′ 2″ / Coal, good 1′ 6″ = **Washington Coal**	3.3	735.3		
Concealed to top Martin well on Coal fork (W.302)	6.7	742.0	122′	
(Samuel Martin No. 1 Record)				
Unrecorded	112.0	854.0		
Coal, Waynesburg horizon supplied	0.0	854.0		
Unrecorded	68.0	922.0		
Coal, Uniontown	0.0	922.0	Monongahela 320′	
Unrecorded	155.0	1077.0	Series.	
Coal, Sewickley, Upper	0.0	1077.0		
Unrecorded	95.0	1172.0		
Coal, Pittsburg	2.0	1174.0		

	Thickness Feet	Total Feet	
Unrecorded	418.0	1592.0	Conemaugh,
Big Dunkard sand	0.0	1592.0	Allegheny and
Unrecorded	410.0	2002.0	968′
Salt sand	140.0	2142.0	Pottsville
Unrecorded	100.0	2242.0	Mauch Chunk
Big lime	50.0	2292.0	Greenbrier Limestone.
Big Injun sand	200.0	2492.0	Pocono
Unrecorded	460.0	2952.0	660′
Red rock	0.0	2952.0	
Unrecorded	130.0	3082.0	
Gordon stray sand	0.0	3082.0	
Unrecorded	40.0	3122.0	Upper
Gordon sand (gas 3125)	7.0	3129.0	910′
Slate and shells	294.0	3423.0	Devonian
Shells	119.0	3542.0	
Slate and shells	315.0	3857.0	
Sand, dark, gray Speechley?	5.0	3862.0	

A section measured by hand-level up the river hill, 3 miles below New Martinsville, gave the following succession of strata:

River Hill Section, 3 Miles Southeast of New Martinsville.

	Thickness Feet	Total Feet	
Shale, limy with limestone nuggets capping high knob, 3-4 miles S. 45° E. of Sardis, O.	3.0	3.0	
Sandy shale and sandstone	41.6	44.6	65.9′
Concealed	20.8	65.4	
Limestone, gray and hard (6″)	0.5	65.9	
Concealed	25.0	90.9	
Sandstone, flaggy	15.6	106.5	54.2′
Concealed	13.6	120.1	
Limestone, gray and hard, Nineveh (Top 1106.5′ A. T.)	2.0	122.1	
Reds, thin sandstones and sandy shale	16.6	138.7	
Sandstone, massive	5.0	143.7	
Concealed and red shale	46.8	190.5	123′
Sandstone, massive, forming great cliff (Fish Creek) light gray, and micaceous	47.6	238.1	
Shale, sandy, 0′ to	5.0	243.1	

(983′ A. T.)

	Thickness Feet	Total Feet	
Coal, Fish Creek, (2″) to....	0.5	243.6	
Fire clay and concealed.....	16.8	260.4	
Shale, red.....	21.0	281.4	
Sandstone, massive.....	15.6	297.0	
Shale, red.....	10.0	307.0	
Fire clay, dark gray, (Dunkard coal)	0.4	307.4	
Shales	4.0	311.4	71.5′
Coal, slaty, 0′ 9″ | Coal..... 0′ 5″ | Slate, gray 0′ 4″ | Coal, slaty 0′ 8″ | Coal ..... 0′ 6″ | S'ate, black 0′ 6″ | **Jollytown Coal** .... (3′ 2″ (Bot. 912′ A. T.)	3.2	314.6	
Shales, limy....	9.0	323.6	
Limestone, hard, silic. Upper Washington	1.0	324.6	
Sha'e, red and sandstone friable	26.0	350.0	
Concealed and reds.....	26.4	377.0	
Sandstone	10.0	387.0	
Concealed	42.4	429.4	
Massive sandstone.....	20.0	449.4	199.4′
Concealed	30.4	479.8	
Sandstone, massive (quarry rock) Marietta	25.0	504.8	
Shale, dark gray.....	5.0	509.8	
Limestone, silicious, impure, Lower Washington	0.2	510.0	
Sha'e, dark gray.....	4.0	514.0	
Slate, black, streaks coal 1′ 6″ Coal, ... **Washington coal** 1′ 6″...	3.0	517.0	(710 A. T.)
Concealed and shale.....	12.4	529.4	
Sandstone, massive, friable, **Mannington**	50.0	579.4	113′
Concealed to B. & O. R. R. grade (632 A T.).....	15.6	595.0	
Concealed to river, water leve'	32.0	627.0	

The Waynesburg coal horizon in the above section is near river level at this point and the total measurement of 627 feet is possibly all in the Dunkard series.

Another section measured by aneroid southwest down the hill road between Pine Grove and Hastings, Wetzel county, and joined to the log of the Camden core test at Pine Grove (W 128) exhibits the following:

Pine Grove, Wetzel County Section.

	Thickness Feet	Total Feet		
Unrecorded from top high knob	240.0	240.0		
Shale with thin sandstone....	9.0	249.0	249′	
Limestone, gray and hard (8″)	1.0	250.0		
Shale	5.0	255.0		
Sandstone, concealed and shale	60.0	315.0	136′	
Sandstone, massive, **Nineveh**..	70.0	385.0		
Sandy shale	10.0	395.0		
Concealed	55.0	450.0		
Shale, red and buff.....	15.0	465.0		
Sandstone	10.0	475.0		
Concealed	17.0	492.0		
Sandstone, limy and yellow....	3.0	495.0		
Shale, variegated	20.0	515.0	235′	
Concealed	10.0	525.0		
Shale, red and variegated.....40.0		565.0		
Concealed	5.0	570.0		Dunkard 921′ Series.
Shale, variegated and red....	45.0	615.0		
Sandstone, friable, Fish Creek.	10.0	625.0		
Shale, gray.....	5.0	530.0		
Coaly slate (2″) **Jollytown**....	0.0	630.0		
Sandstone, massive top, flaggy at bottom.....	15.0	645.0		
Concealed, thin sandstone and gray shale.....	25.0	670.0	165′	
Massive sandstone, (quarry rock on hill side opposite)..	55.0	725.0		
Shales, variegated and red....	35.0	760.0		
Sandstone, massive, Marietta..	33.0	793.0		
Shale, gray.....	2.0	795.0		
Coal, slaty 1′ 0″ | Slate, gray, 0′ 4″ | **Washington** Coal, slaty, 1′ 0″ \} 4′ 6″ Slate, black, 0′ 2″ | **Coal** Coal, slate, 1′ 0″ | (732L.A.T.) Coal, good. 1′ 0″ |	5.0	800.0		
Shale, thin sandstones and shale to forks of road, Pine Grove	20.0	820.0	126′	
Concealed to top boring	17.0	837.0		
(J. N. Camden boring log) Unrecorded in well.....	84.0	921.0		
Coal, Waynesburg	0.5	921.5		
Fire clay.....	5.3	926.8		
Sandstone	4.0	930.8		
Fire clay.....	2.0	932.8		
Sandstone, Gilboy.....	32.0	964.8		
Soft shale, gray.....	7.0	971.8		

	Thickness Feet	Total Feet		
Sandy shale	3.0	974.8		
Soft shale, gray	4.0	978.8	96.5′	
Sandy shale	2.0	980.8		
Sandstone, blue	8.0	988.8		
Sandy shale and sandstone	23.0	1011.8		
Soft shale, gray	5.7	1017.5		
Coal, Uniontown	1.5	1019.0		
Fire clay	0.1	1019.1		
Sandstone	7.7	1026.8		
Soft gray shale	2.0	1028.8		
Sandstone	22.0	1050.8		
Limestone	10.0	1060.8		
Sandy shale	2.0	1062.8		
Limestone	17.0	1079.8		
Sandy shale	3.0	1082.8	145.3′	
Soft gray shale	4.0	1086.8		
Sandy shale	2.0	1088.8		
Limy shale	5.0	1093.8		
Limestone	20.0	1113.8		
Gray shale	3.0	1116.8		Monongahela 352′ Series
Limestone	10.0	1126.8		
Gray shale	2.0	1128.8		
Limestone	31.0	1159.8		
Soft gray shale	3.0	1162.8		
Coal, Sewickley, Upper	2.2	1165.0		
Sandstone	4.0	1169.0		
Soft gray shale	11.8	1180.8		
Limestone	6.0	1186.8		
Limy shale	10.0	1196.8		
Sandstone	6.0	1202.8		
Limy shale	4.0	1206.8	81.7′	
Limestone	5.0	1211.8		
Sandstone	16.0	1227.8		
Shale, gray	8.0	1235.8		
Sandstone, shaly	3.0	1238.8		
Shale, gray	5.7	1244.5		
Coal, Redstone	1.6	1246.1		
Sandy shale	3.7	1249.8		
Limestone	12.0	1261.8		
Soft gray shale	2.0	1263.8	28.5′	
Sandstone	2.0	1265.8		
Shale, gray	5.0	1270.8		
Coal, Pittsburg, (2′ 2″)	2.2	1273.0		
Unrecorded in S. L. Jolliffe No. 1 gas well near by	1249.0	2522.0		Conemaugh, Allegheny, Pottsville, Mauch Chunk and Greenbrier Limestone.
Big Injun sand	250.0	2772.0		Pocono

A section measured by aneroid, southwest down the hill road from Wileyville, Wetzel county, W. Va., in conjunction with the log of an oil well (W 114) on the Ebenezer Dakon farm near the foot of the hill gives the following succession:

Wileyville Section.

	Thickness Feet	Total Feet		
Massive sandstone, capping hill coarse brown, micaceous....	15.0	15.0	35′	
Sandstone, shale and sandstone	20.0	35.0		
Limestone, gray and hard, Windy Gap	1.0	36.0		
Concealed	10.0	46.0		
Reds	5.0	51.0		
Sandy shale.....	30.0	81.0		
Fire, clay, trace.....	0.0	81.0		
Concealed	40.0	121.0		
Sandstone, massive, **Gilmore**...	20.0	141.0		
Concealed and shale.....	45.0	186.0		
Sandstone, flaggy	10.0	196.0	315′	
Concealed	10.0	206.0		
Sandstone, massive, shale in middle, **Taylor**	45.0	251.0		
Concealed and shale	40.0	291.0		Dunkard 963′ Series
Sandstone, massive, **Nineveh**..	25.0	316.0		
Concealed	10.0	326.0		
Shale and sandstone.....	22.0	348.0		
Shale	2.0	350.0		
Coal, Nineveh, (6″).....	1.0	351.0		
Limestone, dark gray, **Nineveh** (10″)	1.0	352.0		
Concealed and shale.....	35.0	387.0	127′	
Sandstone, friable	20.0	407.0		
Concealed and reds.....	60.0	467.0		
Massive sandstone and shale..	10.0	477.0		
Fire clay (6″) Fish Creek coal horizon	0.0	477.0		
Concealed to top oil well (W114)	35.0	512.0	486′	
Unrecorded in well.....	451.0	963.0		
(Coal, Waynesburg supplied from nearby well record)..	4.0	967.0	Monongahela 315′ Series.	
Unrecorded	305.0	1272.0		
Coal, Pittsburg	6.0	1278.0		

A section formed from the log of the Geo. Adams No. 1 oil well near Clyde, 2 miles northeast of Wileyville, Wetzel county, in the Steels Run oil field, in conjunction with the log of another well on the J. A. Lemasters farm located 6-10 mile southeast (See Vol. 1-(a), page 203) gives the following succession of strata.

Steels Run, Wetzel County Section.

	Feet Thickness	Feet Total	
Concealed from top of high knob southwest of well.... (Geo. Adams No 1 and J. A. Lemasters' No. 1 logs)....	50.0	50.0	Dunkard 1180' Series.
Unrecorded	1130.0	1180.0	
Coal, Waynesburg	4.0	1184.0	Monongahela 315' Series.
Unrecorded	305.0	1489.0	
Coal, Pittsburg	6.0	1495.0	
Unrecorded	1150.0	2645.0	Conemaugh, Allegheny, Pottsville and Mauch Chunk.
Big Lime	45.0	2690.0	Greenbrier Limestone.
Big Injun Sand	240.0	2930.0	Pocono.
Unrecorded	578.0	3508.0	Upper Devonian.
Gordon Sandstone	25.0	2533.0	

Oil shown at 3508 and oil at 3522'

The thickness of the Dunkard series in this section is shown to be 1180 feet, the greatest found in the Marshall-Wetzel-Tyler area or for that matter probably the greatest in the State of West Virginia.

The Pittsburg coal seam also reaches the lowest elevation above tide (50 feet A. T., at bottom of seam) yet reported from any other portion of the Appalachian field.

Another section measured by aneroid from top of the "Owlshead" Knob at Jacksonburg, Wetzel county, southwest along point to the Washington coal seam and connected with the log of the G. W. T. Anderson No. 4 oil well at mouth of Richwood run just above the town, exhibits the following:

Owlshead Knob (Jacksonburg) Section.

		Thickness Feet	Total Feet		
Sandstone, massive and flaggy from top of knob		50.0	50.0	70′	
Concealed and shale to bench		20.0	70.0		
Sandstone, very massive	"Gilmore" Sandstone?	100.0	170.0		
Concealed to bench		15.0	185.0		
Sandstone, massive		50.0	235.0		
Concealed to bench		5.0	240.0		
Sandstone, flaggy to bench, **Taylor**		40.0	280.0		
Concealed, sandstone and reds		55.0	335.0		
Sandstone, massive, **Nineveh**		15.0	350.0		
Concealed and red shale		60.0	410.0		
Sandstone, flaggy		30.0	440.0	675′	
Red shale		15.0	455.0		Dunkard 888′ Series.
Sandstone, massive		25.0	480.0		
Concealed and red shale		20.0	500.0		
Massive sandstone, reds and concealed		130.0	630.0		
Sandstone, massive, **Marietta**		25.0	655.0		
Shale, concealed, sandstone and shale		65.0	720.0		
Concealed		15.0	735.0		
Shales		10.0	745.0		
Coal, slaty, 1′ 0″					
Slate, black, 0′ 3″					
Coal, 2′ 4″					
Slate, black, 0′ 4″					
Coal, streaks of slate, 1′ 1″	**Washington Coal** (7′ 8″)	7.7	752.7		
Slate, black, 0′ 8″					
Shale, gray, 1′ 0″				143′	
Coal, bony, 0′ 6″					
Coal, good, 0′ 6″					
Shale and concealed to top G. W.T. Anderson well No. 4 (W. 175)		20.3	773.0		
(G. W. T. Anderson No. 4 Record).					
Unrecorded		50.0	823.0		
Coal, Waynesburg "A"		0.0	823.0		
Unrecorded		65.0	888.0		
Coal, Waynesburg		0.0	888.0		
Unrecorded		105.0	993.0		
Coal, Uniontown		0.0	993.0		Monongahela 247′ Series.
Unrecorded		140.0	1133.0		
Coal, Sewickley, Upper		0.0	1133.0		
Unrecorded		114.0	1247.0		
Coal, Pittsburg		8.0	1255.0		

	Thickness Feet	Total Feet	
Unrecorded	512.0	1767.0	Conemaugh 572' Series.
Dunkard sand	60.0	1827.0	
Unrecorded	146.0	1973.0	Allegheny, Pottsville and 646'
Salt sand	300.0	2273.0	
Unrecorded	200.0	2473.0	Mauch Chunk
Big Lime	47.0	2520.0	Greenbrier Limestone
Big Injun Sand	250.0	2770.0	
Unrecorded	113.0	2883.0	Pocono 393'
Squaw sand (Upper Gas sandstone)	30.0	2913.0	
Unrecorded	367.0	3280.0	
Stray sand	15.0	3295.0	Catskill or 450'
Unrecorded	5.0	3300.0	
Gordon sand	35.0	3335.0	Upper Devonian
Unrecorded to bottom	28.0	3363.0	

A section given by the detailed log of well No. 5 on the Blackshere, Wells & Co., land (W 198) on the head of Arches fork, ½ mile above Arches Post Office in the southeast corner of Wetzel county gives the following succession of the rocks in that region:

Arches Fork Section, Wetzel County.

	Thickness Feet	Total Feet		
Unrecorded from top of high knob on northeast to top of well	625.0	625.0	667'	
(Blackshere, Wells & Co. No. 5 Record).				
Surface material	22.0	647.0		
Red rock	20.0	667.0		
Sandstone, (Upper Marietta).	40.0	707.0		
Black slate	15.0	722.0	98'	Dunkard 910' Series.
Limestone, **Middle Washington**	20.0	742.0		
Red rock	23.0	765.0		
Coal, **Washington**	5.0	770.0		
Sandstone	15.0	785.0		
Limestone	30.0	815.0		
Black slate, **Waynesburg "A" coal**	15.0	830.0	145'	
Sandstone	30.0	860.0		
Slate	15.0	875.0		
Red rock	15.0	890.0		
Slate	20.0	910.0		

	Thickness Feet	Total Feet		
Sandstone, (Gilboy)	70.0	980.0		
Slate	10.0	990.0		
Sandstone	35.0	1025.0		
Slate	60.0	1085.0	Monongahela	
Limestone	50.0	1135.0	375′	
Sandstone	20.0	1155.0	Series	
Limestone	35.0	1190.0		
Slate	85.0	1275.0		
Coal, Pittsburg	10.0	1285.0		
Slate	20.0	1305.0		
Limestone	50.0	1355.0		
Sandstone	35.0	1390.0		
Limestone	20.0	1410.0	235′	
Red rock	50.0	1460.0		
Slate	60.0	1520.0		Conemaugh
Limestone	15.0	1535.0		560′
Red rock, Pittsburg red shale	80.0	1615.0		Series
Unrecorded	40.0	1655.0		
Limestone	10.0	1665.0		
Sandstone, **(Saltzburg)**	45.0	1710.0	325	
Slate	70.0	1780.0		
Dunkard sandstone **(Mahoning)**	50.0	1830.0		
Slate	15.0	1845.0		
Sandstone, **Upper Freeport**	65.0	1910.0		
Slate	35.0	1945.0		
Limestone	15.0	1960.0	Allegheny 310′ Series	
Slate	45.0	2005.0		
Sandstone, **(Lower Freeport)**	60.0	2065.0		
Slate	75.0	2140.0		
Sandstone	85.0	2225.0	Pottsville	
Slate	10.0	2235.0	275′	
Salt sand	180.0	2415.0	Series	
Red rock	80.0	2495.0		
Shells	15.0	2510.0	Mauch Chunk 140′	
Limestone	37.0	2547.0		
Pencil cave	8.0	2555.0		
Big lime	54.0	2609.0	Greenbrier Limestone	
Keener sand	21.0	2630.0	Pocono	
Big Injun sand	138.0	2768.0	159′	

Gas at 2684 and oil at 2703.

A section in the northeast corner of Wetzel county measured by hand level on Church fork of Fish creek northeast down hill, 1 mile north of Burton, in conjunction with the log of the Sarah Anderson No. 1 oil well (W. 1), exhibits the following:

Burton Section, Wetzel County.

Sandstone, mostly from top of high knob west of summit of Burton hill road	43.0	43.0		
Massive sandstone, concealed to bench	31.2	74.2	105.4′	
Concealed and sandstone, massive, Gilmore	31.2	105.4		
Concealed to summit of Burton hill road	20.8	126.2		
Sandstone and shale	15.0	141.2		
Shale, buff	10.0	151.2	129.4′	
Concealed	36.4	187.6		
Buff shale	5.2	192.8		
Sandstone, massive. Buff sandy shale. Sandstone, massive,	Taylor Sandstone	10.4 / 5.2 / 26.4	203.2 / 208.4 / 234.8	
Concealed	5.2	240.0		
Limy, dark gray shale, with limestone nuggets	5.0	245.0		
Sandtsone, with shale layers	10.4	255.4		
Buff shale	8.4	263.8		
Concealed	2.0	265.8	86.0′	
Black slate	0.0	265.8		
Concealed	26.0	291.8		
Sandstone, friable, sandy shale, and sandstone	26.0	317.8		
Shale, sandy and gray	3.0	320.8		
Coal, Nineveh (11″) to (1230′ B. A. T.)	1.0	321.8		
Shale	3.4	325.2		
Limestone, yellowish and silicious	2.0	327.2		
Shale	5.2	332.4	73.6′	
Fireclay, dark gray	1.0	333.4		
Concealed and shale	16.8	350.2		
Sandstone, massive, Burton	40.0	390.2		Dunkard 959′ Series
Sandy shale	4.2	394.4		
Coal, Hostetter 10″ to	1.0	395.4		
Fire clay and sandy shale	10.4	405.8		
Sandstone, friable	31.2	437.0		
Fire clay and concealed	5.2	442.2	84.6′	
Sandstone, friable	15.6	457.8		
Concealed to top of Sarah Anderson No. 1 oil well	21.2	479.0		
(Sarah Anderson No. 1 Record.)				
Sand and gravel from top of hole	18.0	497.0	98′	
Slate and shells	80.0	577.0		

	Thickness Feet	Total Feet		
Coal, Jollytown	2.0	579.0		
Slate	15.0	594.0		
Limestone, **Upper Washington**	40.0	634.0		
Slate and shells	45.0	679.0		
Red rock	10.0	689.0		
Slate	5.0	694.0		
Lime	5.0	699.0		
Slate	5.0	704.0		
Red rock	15.0	719.0		
Sandstone, (10″ casing top of sand)	30.0	749.0	257′	
Red rock	5.0	754.0		
Slate, white	10.0	764.0		
Slate, black	5.0	769.0		
Lime, **Middle Washington**	10.0	779.0		
Slate	20.0	799.0		
Lime	5.0	804.0		
Slate	11.0	815.0		
Black shells	14.0	829.0		
Limestone, **Lower Washington.**	5.0	834.0		
Coal, Washington (little water)	2.0	836.0		
Slate	33.0	869.0		
Lime	20.0	889.0		
Sandstone	20.0	909.0	125′	
Slate	5.0	914.0		
Lime, dark	5.0	919.0		
Lime, white	20.0	939.0		
Slate	20.0	959.0		
Coal, Waynesburg	5.0	964.0		
Limestone, **Waynesburg**	29.0	993.0		
Slate	6.0	999.0	252′	
Sandstone, **Gilboy**	34.0	1033.0		
Slate	20.0	1053.0		
Lime	158.0	1211.0		Monongahela 362′ Series.
Coal, Sewickley, Upper	8.0	1219.0		
Lime	53.0	1272.0		
Slate	5.0	1277.0	110′	
Lime	27.0	1304.0		
Slate	9.0	1313.0		
Coal, Pittsburg	8.0	1321.0		
Lime	6.0	1327.0		
Slate and shells	35.0	1362.0		
Red rock	5.0	1367.0		
Red lime	10.0	1377.0		
Red rock	27.0	1404.0		
Lime	15.0	1419.0		
Slate	20.0	1439.0		
Red rock	10.0	1449.0		
Lime	18.0	1467.0		
Red rock	17.0	1484.0		

	Thickness Feet	Total Feet		
Lime	5.0	1489.0		
Red rock	13.0	1502.0		
Lime	22.0	1524.0		
Red rock	5.0	1529.0		
Lime	10.0	1539.0		
Slate and shells	21.0	1560.0	328′	
Lime	5.0	1565.0		
Slate	54.0	1619.0		
Sandstone, **Saltzburg**	31.0	1650.0		
Coal, Bakerstown	5.0	1655.0		
Slate	52.0	1707.0		
Lime (8″ casing)	15.0	1722.0		Conemaugh 550′ Series
Sandstone, (**Buffalo**)	22.0	1744.0		
Slate	35.0	1779.0	178′	
Lime	10.0	1789.0		
Sandstone, **Upper Mahoning**	37.0	1826.0		
Slate	4.0	1830.0		
Coal, Mahoning	3.0	1833.0		
Sandstone, (Lower Mahoning)	38.0	1871.0	38′	
Slate	18.0	1889.0		
Sandstone, (Upper Freeport)	30.0	1919.0	50′	
Coal, Lower Freeport	2.0	1921.0		
Limestone, (**Lower Freeport**)	23.0	1944.0		
Sandstone, (**Lower Freeport**)	40.0	1984.0		
Slate	5.0	1989.0		Allegheny 231′ Series
Lime	15.0	2004.0	165′	
Sandstone (Clarion)	50.0	2054.0		
Slate	27.0	2081.0		
Coal gum, Clarion	5.0	2086.0		
Limestone	16.0	2102.0	16′	
Gas sand, **Homewood**	100.0	2202.0	Pottsville 248′ Series.	
Slate, and shells	50.0	2252.0		
Salt sand, gas 80 feet in	98.0	2350.0		
Slate	45.0	2395.0		
Red rock	4.0	2399.0		
Slate and shells	21.0	2420.0	Mauch	
Maxton sand	42.0	2462.0	142	
Slate	14.0	2476.0	Chunk	
Limestone	12.0	2488.0		
Slate	4.0	2492.0		
Big lime (6″ casing)	80.0	2572.0	Greenbrier Limestone	
Big Injun sand	232.0	2804.0		
Slate and shells	10.0	2814.0		
Lime	10.0	2824.0		
Slate and shells	20.0	2844.0		
Lime	80.0	2924.0		
Slate	10.0	2934.0		

	Thickness Feet	Total Feet		
Lime	5.0	2939.0		
Slate	5.0	2944.0	Pocono 532′	
Lime	20.0	2964.0		
Slate and shells	80.0	3044.0		
Lime	15.0	3059.0		
Slate and shells	30.0	3089.0		
Sandstone, Berea	15.0	3104.0		
Lime	40.0	3144.0		
Slate	15.0	3159.0		
Lime	6.0	3165.0		
Slate	37.0	3202.0	160′	
Lime	13.0	3215.0		
Pink rock	15.0	3230.0		
Slate and shells	34.0	3264.0		
Sand, 10′ Slate, 5′ Sand, 9′ Slate, 10′ Sand, 6′ Slate, 5′ Sand, 21′	**Gantz and fifty-foot sands**	66.0	3330.0		Catskill, or 443′ Upper Devonian
Slate	8.0	3338.0	136′	
Thirty-foot sand	35.0	3373.0		
Pink sand	3.0	3376.0		
Gordon stray sand	28.0	3404.0		
Slate	4.0	3408.0		
Gordon sand	68.0	3476.0		
Slate	25.0	3501.0		
Fourth sand	44.0	3544.0	139′	
Slate to bottom	2.0	3547.0		

First oil pay at 3526′; Second oil pay at 3532′. Made 50 bbls. an hour from both pays in the first 24 hours, but declined in a short time to less than 100 bbls. per day. It is still producing and is 5 years old.

A section measured by aneroid 7 miles east of Middlebourne, on head of Big run of Indian creek, in conjunction with the log of a gas well on the same stream on the W. W. Myers (T. 137) farm, drilled by the Tri State Gas Company and authority for record of well, exhibits the following:

Big Run of Indian Creek Section, Tyler County.

	Thickness Feet	Total Feet		
Shales on top of hill, head of Big run	10.0	10.0		
Sandstone, interlaminated with shale	20.0	30.0		
Shale, buff	5.0	35.0		
Shale, buff and red	15.0	50.0		
Sandstone, massive	20.0	70.0		
Concealed and red shale	10.0	80.0		
Sandstone, massive to fork of road	15.0	95.0		
Shale, concealed and reds	40.0	135.0	330′	
Sandstone, friable, greenish	20.0	155.0		
Concealed	35.0	190.0		
Sandstone, friable at top	10.0	200.0		
Concealed	10.0	210.0		
Shale, red and buff	20.0	230.0		
Sandstone, massive	30.0	260.0		
Concealed to foot of hill road head of Big run	25.0	285.0		
Sandstone, massive, concealed and reds	45.0	330.0		Dunkard 528′ Series
Shale, dark, bituminous (3″) **Washington "A" Coal**	0.0	330.0	65′	
Concealed	65.0	395.0		
Coal, Washington	3.0	398.0		
Concealed to top of Myers' well	5.0	403.0		
W. W. Myers No. 1 Record.			133′	
Clay	15.0	418.0		
Sandstone, **Mannington**	50.0	468.0		
Slate	50.0	518.0		
Limestone	10.0	528.0		
Slate	40.0	568.0		
Limestone	20.0	588.0		
Slate	50.0	638.0		
Limestone	115.0	753.0		
Coal, Sewickley	4.0	757.0	Monongahela 331′ Series	
Limestone	10.0	767.0		
Slate	21.0	788.0		
Sandstone	30.0	818.0		
Slate	40.0	858.0		
Coal, Pittsburg	1.0	859.0		
Limestone	14.0	873.0		
Slate	20.0	893.0		
Sandstone, **Connellsville?**	40.0	933.0		
Slate	40.0	973.0		
Red rock	5.0	978.0		
Slate	50.0	1028.0		

	Thickness Feet	Total Feet	
Red rock	15.0	1043.0	
Limestone	15.0	1058.0	Conemaugh
Red rock	30.0	1088.0	574′
Slate	50.0	1138.0	Series
Red rock	30.0	1168.0	
Limestone	15.0	1183.0	
Slate	65.0	1248.0	
Limestone	20.0	1268.0	
Slate	20.0	1288.0	
Sandstone	15.0	1303.0	
Slate	50.0	1353.0	
Sandstone, **Mahoning**	50.0	1403.0	
Slate	30.0	1433.0	
Slate	20.0	1453.0	
Sandstone	60.0	1513.0	
Coal, Lower Freeport	4.0	1517.0	Allegheny
Sandstone, **Lower Freeport**	51.0	1568.0	255′
Slate	75.0	1643.0	Series
Sandstone	20.0	1663.0	
Slate	25.0	1688.0	
Sandstone	85.0	1773.0	
Slate	10.0	1783.0	Pottsville
Sandstone	40.0	1823.0	270′
Slate	135.0	1958.0	Series
Red rock	30.0	1988.0	
Slate	35.0	2023.0	
Sand, **Maxton**	10.0	2033.0	Mauch
Slate	10.0	2043.0	115′
Limestone	15.0	2058.0	Chunk
Pencil cave	15.0	2073.0	
Big Lime	80.0	2153.0	Greenbrier Limestone
Big Injun sand	225.0	2378.0	
Slate and shells	135.0	2513.0	430′
Sandstone, **Berea**	70.0	2583.0	Pocono
Slate and shell	260.0	2843.0	
Sandstone, ("30 foot")	20.0	2863.0	
Slate	75.0	2938.0	Catskill, or
Gordon sand	0.0	2938.0	410′
(Gas pay 19½′ in sand)			Upper Devonian
Unrecorded to bottom	55.0	2993.0	

A section measured by aneroid down the hill road southwest of Big Moses on Indian creek, Tyler county, in conjunction with the log of a well on the M. W. Spencer farm (T 149), drilled by the Philadelphia Company, ⅕ mile south of the famous "Big Moses" gas well, gave the following succession:

Big Moses Section, Tyler County.

	Thickness Feet	Total Feet		
Concealed from top of knob..	20.0	20.0		
Sandstone, massive, forming great cliff, coarse, brown and micaceous (**Nineveh**)	40.0	60.0	60′	
Concealed to top hill ridge road	60.0	120.0		
Concealed	35.0	155.0	130′	
Sandstone, massive	35.0	190.0		
Concealed	5.0	195.0		
Red shale	15.0	210.0		
Concealed	10.0	220.0		
Concealed	45.0	265.0		
Shale, variegated and red	45.0	310.0		Dunkard 560′ Series
Sandstone, massive, **Marietta**..	25.0	335.0	217′	
Reds	10.0	345.0		
Concealed	15.0	360.0		
Reds, dark	10.0	370.0		
Sandstone and red shale.....	20.0	390.0		
Concealed	17.0	407.0		
Coal, blossom, Washington...	3.0	410.0		
Shales	35.0	445.0		
Sandstone, **Mannington**, and concealed to top of Spencer well ..... (M. W. Spencer No. 1 Record).	35.0	480.0	153′	
Unrecorded	80.0	560.0		
Unrecorded	352.0	912.0		Monongahela 354′ Series
Coal, **Pittsburg**	2.0	914.0		
Unrecorded	389.0	1303.0		
Little Dunkard sand	15.0	1318.0		
Unrecorded	217.0	1535.0		Conemaugh, Allegheny 1036′ and Pottsville
Gas sand	29.0	1564.0		
Unrecorded	26.0	1590.0		
Salt sand	360.0	1950.0		
Unrecorded	154.0	2104.0		Mauch
Little Lime	16.0	2120.0		294′
Pencil cave	34.0	2154.0		Chunk
Big Lime	83.0	2237.0		Greenbrier Limestone
Big Injun sand.....	175.0	2412.0		Pocono
Unrecorded	570.0	2982.0		Upper
Gordon sand	16.0	2998.0		1105
Slate, soft to bottom.....	519.0	3517.0		Devonian.

A section measured by aneroid down the hill road on Winze run branch of Sancho creek and joined to the log of a well (T. 111) on the J. R. Baker farm drilled by the Carter Oil Company, located 2 miles south of Middlebourne, Tyler county, gives the following succession of strata:

Middlebourne Section, Tyler County.

	Thickness Feet	Total Feet		
Concealed from top of high knob	5.0	5.0	35′	
Sandstone, flaggy, **Nineveh?**	30.0	35.0		
Concealed to bench	20.0	55.0		
Concealed and sandstone	25.0	80.0		
Buff shale and reds	15.0	95.0		
Reds and concealed	15.0	110.0		
Red and buff shale	20.0	130.0	165′	
Sandstone with red shale layers	25.0	155.0		
Concealed	10.0	165.0		
Red shale	20.0	185.0		
Sandstone, massive, **Fish Creek?**	15.0	200.0		Dunkard 602′ Series
Concealed	95.0	295.0		
Sandstone, massive	50.0	345.0		
Concealed and shale	35.0	380.0	280′	
Sandstone, massive	35.0	415.0		
Concealed	65.0	480.0		
Coal, Washington (18″ to 24″)	2.0	482.0		
Concealed, mostly massve sandstone	50.0	532.0		
Coal, blossom, Waynesburg "A"	0.0	532.0	120′	
Concealed to top Baker well.. (J. R. Baker No. 1 Record.)	20.0	552.0		
Unrecorded	50.0	602.0		
Unrecorded	350.0	952.0	Monongahela 353′ Series	
Coal, Pittsburg	3.0	955.0		
Unrecorded	157.0	1112.0		
Cave	230.0	1342.0	Conemaugh, Allegheny 1167′	
Unrecorded	145.0	1487.0		
Salt sandstone?	425.0	1912.0	Pottsville and Mauch Chunk	
Unrecorded	210.0	2122.0		
Big Lime hard	55.0	2177.0	Greenbrier Limestone	
Big Injun sand	165.0	2342.0	Pocono	
Unrecorded	22.0	2364.0		

About 1 mile northwest of McKim Post Office, Tyler county, an accurate section of the rocks is obtained from the detailed log of an oil well No. 1 on the Moses Johnson (T. 229) farm, published in Volume 1-(a) of the Survey reports on pages 259 and 269). It gives the following:

McKim Section, Tyler County.

	Thickness Feet	Total Feet		
Concealed from top of high knob on the northeast to top of well	280.0	280.0		
(Moses Johnson No. 1 Record.) (Top—1082L—A. T.)				
Surface and soil	5.0	285.0		
Red rock	50.0	335.0		
Brown shale	12.0	347.0		
Red rock	23.0	370.0		
Sandstone	60.0	430.0	595′	
Green slate	10.0	440.0		
Sandstone, hard	20.0	460.0		
Slate, dark gray	12.0	472.0		
Sandstone	38.0	510.0		
Green slate	4.0	514.0		
Red rock	46.0	560.0		
Sandstone, hard	15.0	575.0		Dunkard 705′ Series
Slate	10.0	585.0		
Slate	10.0	595.0		
Coal, trace, Washington	0.0	595.0		
Slate	10.0	605.0		
Sandstone, micaceous, **Mannington**	85.0	690.0	110′	
Red rock	15.0	705.0		
Limestone	25.0	730.0		
Slate	2.0	732.0		
Red rock	20.0	752.0	77′	
Sandstone, coarse	30.0	782.0		
Slate, black 4′ 0″ } **Uniontown** Coal, trace, 0′ 0″ } Slate, black 4′ 0″ } **coal**	8.0	790.0		Monongahela 335′ Series
White slate	20.0	810.0		
Sandstone	10.0	820.0		
White slate	2.0	822.0		
Red rock	15.0	837.0		
Slate (10″ csg. to 557′ from top of hole	40.0	877.0	258′	
Limestone	32.0	909.0		
Slate	6.0	915.0		

	Thickness Feet	Total Feet	
Lime and shells	55.0	970.0	
Sandstone	10.0	980.0	
Slate	10.0	990.0	
Limestone	20.0	1010.0	
Limestone	12.0	1022.0	
Sandstone	17.0	1039.0	
Coal, Pittsburg	1.0	1040.0	
Sandstone	40.0	1080.0	
Sandstone	6.0	1086.0	
Lime and sand shells	50.0	1136.0	
Limestone, sandy	25.0	1161.0	
Sandstone	12.0	1173.0	
Black slate, **trace of coal (Harlem)**	15.0	1188.0	
Red rock, "Big Red"	52.0	1240.0	
Limestone, sandy	30.0	1270.0	
Coarse sand (**Saltzburg**)	40.0	1310.0	
Black slate	16.0	1326.0	
Limestone, sandy	6.0	1332.0	
Red rock	6.0	1338.0	Conemaugh and
Limestone and limy shale	82.0	1420.0	704′
Limestone	21.0	1441.0	Allegheny Series
Slate	39.0	1480.0	
Sandstone, hard	12.0	1492.0	
Shale	25.0	1517.0	
Sandstone	16.0	1533.0	
Limestone, hard	35.0	1568.0	
"Break," soft	5.0	1573.0	
Limestone, hard	6.0	1579.0	
Sandstone, (Lower Freeport)	135.0	1714.0	
Slate	30.0	1744.0	
Coal, trace, **(Lower Kittanning?)**	0.0	1744.0	
Salt sand, water 86′ in	202.0	1946.0	
Black slate	86.0	2032.0	Pottsville
Sandstone	12.0	2044.0	362′
Black slate, (6 5/8″ casing 1776′)	12.0	2056.0	Series
Black grit, very hard on bits	50.0	2106.0	
Shells	10.0	2116.0	Mauch
Maxton sand	55.0	2171.0	84′
Black lime rock	19.0	2190.0	Chunk
Big lime	66.0	2256.0	Greenbrier Limestone
Keener sand	32.0	2288.0	
Big Injun sand (gas 2298, oil 2309)	87.0	2375.0	125′ Pocono
Unrecorded to bottom	6.0	2381.0	

A section measured by hand level, descending hill to B. & O. R. R. grade, ¾ mile above Sistersville, in conjunction with the logs of E. P. Russell No. 4 and J. T. Leasure No. 3 oil wells, gives the following:

Sistersville Section, Tyler County.

	Thickness Feet	Total Feet		
Sandy beds and concealed from top of knob to level of Derrick floor (E. P. Russell No. 4.)	20.0	20.0		
Concealed and red shale	15.0	35.0	127′	
Sandstone, massive	10.0	45.0		
Concealed	27.0	72.0		
Shales, deep red and marly	20.0	92.0		
Sandstone, massive	20.0	112.0		
Shales, sandy and reddish	15.0	127.0		
Coal, Washington "A"	0.5	127.5		
Shales, sandy and reddish	7.0	134.5		
Sandstone, massive and flaggy	15.0	149.5	48.5′	Dunkard 272.5′ Series
Concealed	23.0	172.5		
Shales and concealed, with gray **Limestone layers**	3.0	175.5		
Coal, reported Washington	2.0	177.5		
Concealed and shales	25.0	202.5	56′	
Sandstone, flaggy and massive.	14.0	216.5		
Shales and concealed	15.0	231.5		
Coal, large blossom, Waynesburg "A"	0.0	231.5		
Shales and concealed	17.0	248.5	41′	
Sandstone, flaggy and massive	8.0	256.5		
Shales	12.0	268.5		
Shales, reddish	4.0	272.5		
Coal streak and fire clay shales. **Waynesburg coal**	2.0	274.5		
Sandstone and red shales	20.0	294.5	85′	
Sandstone, flaggy	7.0	301.5		
Concealed, much red shale and sandy beds	56.0	357.5		
Coal 0′ 2″)				Monongahela 322′ Series
Shales, gray and soft 2′ 7″) **Union-**				
Coaly streak, 0′ 3″) **town**				
Shales, gray 3′ 0″) **Coal**	8.0	365.5		
Coal with limy, dark) fossiliferous slate 2′ 0″)				
Shales with limestone nuggets.	8.0	373.5	237′	

	Thickness Feet	Total Feet	
Sandstone, rough, massive, irregular	5.0	378.5	
Sandy shales	7.0	385.5	
Limestone, dark, top Sistersville Limestone	1.0	386.5	
Shales, sandy top, red with gray, limestone and concealed	25.0	411.5	
Flaggy sandstone and sandy shales	10.0	421.5	
Sandy shales, blue	5.0	426.5	
Unrecorded	164.0	590.5	
Coal, Pittsburg	4.0	594.5	
Unrecorded	488.0	1082.5	Conemaugh 508' Series
Sand, Cow Run, (Mahoning)	20.0	1102.5	
Unrecorded	10.0	1112.5	
Sandstone	110.0	1222.5	
Unrecorded	70.0	1292.5	Allegheny, Pottsville 635' and Mauch Chunk
Salt sandstone	65.0	1357.5	
Unrecorded	295.0	1652.5	
Sandstone, Maxton	50.0	1702.5	
Unrecorded	35.0	1737.5	
Big lime	28.0	1765.5	Greenbrier Limestone
Keener sand	22.0	1787.5	
Break of slate	20.0	1807.5	118' Pocono.
Big Injun sand to bottom	76.0	1883.5	

Oil pay 1816.5—1836.5
Oil pay 1842.5—

Another section, measured by aneroid and hand-level northwest to foot of hill at Sistersville along the turnpike leading to Middlebourne, in conjunction with the log of J. B. McCoy No. 15 oil well, drilled by the Carter Oil Company in March, 1906, gives the following:

Turnpike Section, Sistersville, Tyler County.

	Thickness Feet	Total Feet	
Concealed from top of hill	15.0	15.0	
Sandstone	20.0	35.0	
Fire clay horizon (spring)	0.0	35.0	59'
Concealed	20.0	55.0	
Shale	4.0	59.0	

	Thickness Feet	Total Feet		
Coal..... 0′ 6″ **Shale, gray** 0′ 3″ **Coal** ..... 0′ 3″ Supplied from exposure 1-8 mile S. E. **Washington "A"** (945 B. A. T.)	1.0	60.0	94′	
Concealed	10.0	70.0		
Reds	10.0	80.0		
Shale, red and sandy.....	25.0	105.0		
Concealed, shale and concealed	48.0	153.0		
Coal, Washington (21″) (850L—A. T.)	2.0	155.0		Dunkard 255′ Series
Concealed	20.0	175.0	44.	
Sandstone, massive, **Mannington**	16.0	191.0		
Shale	6.0	197.0		
Coal, Waynesburg "A" (at water trough) (810L—A.T.)	3.0	200.0		
Shales and concealed.....	35.0	235.0	58′	
Sandstone and shale.....	20.0	255.0		
Sandstone, massive, **(Gilboy)**, base 705L—A.T.)	50.0	305.0		
Fire clay and dark blossom (6″)	1.0	306.0		
81 feet below top McCoy No. 15 well			70′	
(J. B. McCoy No. 15 Record)				Monongahela 307′ Series
Unrecorded in well.....	19.0	325.0		
Coal, Uniontown, (682 L—A. T.).....	3.0	328.0		
Unrecorded in well.....	230.0	558.0	237′	
Coal, Pittsburg, (supplied from J. T. Leasure No. 3 (T.14-A)	4.0	562.0		
Unrecorded	438.0	1000.0		
Cow Run sand, (Mahoning?).	35.0	1035.0		
Unrecorded	98.0	1133.0	Conemaugh, Allegheny, 1123′	
Sand	52.0	1185.0		
Unrecorded	20.0	1205.0	Pottsville, Mauch Chunk	
Sand	25.0	1230.0		
Unrecorded	455.0	1685.0		
Big Lime	57.0	1742.0	Greenbrier Limestone	
Keener sand	29.0	1771.0		
Break of slate	12.0	1783.0	118′ Pocono	
Big Injun sand to bottom....	77.0	1860.0		

(Oil pay 1783-1813).

A section measured by aneroid northwest down the Wells run road just above Long Reach station on the Ohio river in conjunction with a core test for coal on the Thos. Moore farm (T. 49) gives the following:

Long Reach Section, Tyler County.

	Thickness Feet	Total Feet		
Sandstone and red shale, from top of hill	10.0	10.0	10′	
Fire clay (6″)	1.0	11.0		
Red shale and concealed	45.0	56.0		
Sandstone, flaggy	10.0	66.0		
Shale and concealed	15.0	81.0		
Sandstone, friable at top	30.0	111.0	176′	Dunkard 262′ Series
Concealed	35.0	146.0		
Shale, red and variegated	10.0	156.0		
Red shale and concealed	30.0	186.0		
Coal, (12″ visible) Washington (833 L—A. T.)	1.0	187.0		
Shale	5.0	192.0		
Sandstone massive, **Mannington**	20.0	212.0	76′	
Red shale and concealed	15.0	227.0		
Red shale	10.0	237.0		
Sandstone	19.0	256.0		
Red shale	6.0	262.0		
Concealed	25.0	287.0		
Sandstone, friable, **(Gilboy)**	15.0	302.0	49′	
Shale	9.0	311.0		
Slate, black, 0′ 10″ / **Shale, gray,** 0′ 3″ / **Coal,** 0′ 2″ — **Uniontown Coal** 1′ 3″	1.0	312.0		Monongahela 302.5′ Series
Shale, gray and limy	5.0	317.0		
Limestone, impure (6″)	1.0	318.0		
Sandstone, friable	5.0	323.0		
Red shale	5.0	328.0		
Shale, black, bituminous (2″)	0.0	328.0	253.5′	
Limestone, limy shale and limestone	44.0	372.0		
Concealed to top of core test (T49)	14.0	386.0		
Unrecorded in core test	175.0	561.0		
Coal, Pittsburg	3.5	564.5		

The foregoing sections would give the total thickness of the Carboniferous of the Marshall-Wetzel-Tyler area as 3400 feet, divided as follows:

UPPER CARBONIFEROUS.

	Feet.
Dunkard Series	1180
Monongahela Series..	360
Conemaugh Series ..	560
Allegheny Series ...	300
Pottsville Series.....	300—2700 feet

LOWER CARBONIFEROUS.

	Feet.
Mauch Chunk	150
Greenbrier Limestone	100
Pocono	450— 700 feet
Total	3400 feet

THE DUNKARD SERIES.

The highest group of rocks of the Carboniferous of the Appalachian area is the Dunkard series which is also the most recent in formation except the alluvium along the river bottoms and the large creeks. It was named from Dunkard creek, in the southwestern corner of the state of Pennsylvania by Dr. I. C. White in 1891. His original description follows:

"The uppermost beds are found at the headwaters of Dunkard creek, a large stream which heads near the West Virginia-Pennsylvania line, on the eastern slope of the watershed separating the Ohio and Monongahela river drainage systems, and flowing eastward, puts into the Monongahela two miles above Greensboro, Greene county, Pennsylvania, and four miles north from the West Virginia line. This stream flows over the Permo-Carboniferous rocks from the source to the point at which it leaves the West Virginia line at Mount Morris, Pennsylvania, a distance of more than thirty miles, furnishing very fine exposures of these rocks along its banks and bluffs, hence the geographical name, Dunkard, which I have given the series." (U. S. G. S. Bull. 65, p. 20: 1891.)

Formerly it was supposed that this series of rocks held no coal seams of economic value and for that reason was called the Upper Barren Measures in the early study of the geology in this country.

For a long time this series was placed under a compromise term, Permo-Carboniferous on account of the presence of fossil plants of the Permian age in its shales, and failure to find Permian animal remains.

The base of the Dunkard series was placed by Dr. White at the horizon where Permian plants were first observed in the fossil flora, namely, the Cassville shales just above the Waynesburg coal seam.

The following description of the Dunkard series is given by Dr. White in Vol. II, page 101 of the West Va. Geological Survey reports:

"As exhibited in West Virginia, the rocks of this series consist of a succession of brown and gray sandstones, interstratified with much red shale, many beds of limestone, and several thin, impure and unimportant coal beds, the entire series being slightly gypsiferous throughout, though no accumulations of gypsum have taken place owing probably to the absence of any considerable thickness of limestone beds.

"In Ohio and northern Marshall counties, like Greene and Washington of Pennsylvania, this series holds less red shale and a greater proportion of limestone and gray limy shales than further to the southwest. The coal beds are also more numerous, and the sandstones less massive, the whole resulting in a gentle rolling topography, finely adapted to grazing and agriculture, except along the immediate gorges of the streams.

"As we pass southwestward, however, the coal beds all disappear except one (the Washington) before we reach the Little Kanawha river, and the limestones with one or two exceptions thin away into great masses of marly red shales, holding only nuggets of lime, while the sandstones thicken up, and, capping the ridges in long lines of cliffs, often make a rugged topography better fitted for grazing and fruit culture than for agriculture. When the massive sandstones disappear from the ridges or uplands, however, there frequently occur limited areas of beautiful rolling lands which yield abundant crops, the red marly shales being quite fertile from the disseminated limestone nuggets.

"The soils formed by the disintegration of the Dunkard beds have the reputation of producing a fine quality of wool in which the fiber is peculiarly firm and strong, so that its area is often known as the "sheep belt" of West Virginia, since probably 90 per cent. of the sheep raised in the State are grown upon the outcrops of the Dunkard series. These rocks occupy a belt about 40 to 60 miles in width bordering the Ohio river and extending east from the same over portions or all of the following named counties: Ohio, Marshall, Wetzel, Tyler, Monongalia, and Marion (west of the Monongahela river), western Harrison and Lewis, Doddridge, Pleasants, Wood, Wirt, Ritchie, Calhoun, Gilmer, Roane, Jackson, and the uplands of Mason and southern Putnam, but tailing out into a narrow belt, which soon overshoots even the highest hills of Wayne, a short distance east from the Big Sandy river at the Kentucky boundary."

The following is the type section of the Dunkard series of rocks by Dr. I. C. White as exposed along Dunkard creek from the head of its Pennsylvania fork in Gilmore township, Greene Co., Pa. to Mt. Morris.

Dunkard Creek Section.[4]

	Ft.	In.	Ft.	In.
Concealed from top of Shough's Knob.	165			
Sandstone, massive, Gilmore	40			
Shales, with limestone at base	15			
Sandstone and shales and concealed	100			
Shale, red	2			
Shales, gray	20			
Shale, marly	2		480	
Sandstone and shale	35			
Red shale	3			
Sandstone and shale	50			
Red shale	3			
Shales and sandstone, Nineveh	25			
Shales	20			
Coal, Nineveh	1	6		
Shales	28			
Limestone (No. X). Nineveh	7			
Shales, sandstone and concealed	100			
Sandstone, massive, Fish Creek	20			
Shales with fossil plants	10			

4. I. C. White in W. Va. Geol. Sur. Vol. II, p. 102.

	Ft.	In.	Ft.	In.
Coal, Dunkard { coal 0′ 5″ / slate 0′ 1″ / coal 0′ 6″ }	1			
Limestone	1		223	1
Sandstone	10			
Shales	17			
Limestone, Jollytown	1			
Shales and sandstone	25			
Coal, Jollytown	1	1		
Calcareous shales, fossiliferous, fish teeth	0	6		
Limestone, Upper Washington	4			
Shales and sandstone	115			
Limestone, Middle Washington	3			
Shales	40			
Sandstone	35		276	8
Shale	5			
Coal, Washington, "A" { coal, impure 1′ 2″ / fire clay 2′ 6″ / coal 0′ 6″ }	4	2		
Shales and sandstones	60			
Limestone, Lower Washington	5			
Shales	5			
Coal, Washington, slaty	5			
Shales and sandstones, including coal bed near center	110			
Coal, Waynesburg "A"	2	6	177	6
Shales	10			
Sandstone, Waynesburg	50			
Shales, with fossil plants (Cassville). **Waynesburg coal.**	5			
Total			1162	3

The following section of the Dunkard series was measured by Dr. I. C. White in Washington county, Pennsylvania, adjoining the area described in this report on the northeast, and is given to show the position of the Washington and Jollytown coal seams with respect to the Washington limestones:

Washington, Pennsylvania Section[5]

	Ft.	In.	Ft.	In.
Limestone, Jollytown			10	
Shale			5	
Coal, Jollytown			1	

5. U. S. G .S. Bull. 65, pp. 29 and 30.

	Ft.	In.	Ft.	In.
Sandstone	10			
Dark shale	8			
Limestone, Upper Washington	30			
Concealed	50		190	
Coal, blossom	0			
Concealed	80			
Limestone, Lower Washington	12			
Coal, Wshington	7			
Clay	4			
Sandstone	9			
Concealed	10			
Limestone	2			
Shales, lmestone, concealed	65		117	6
Black slate	1	6		
Limestone	4			
Blue shale	15			
Waynesburg coal.				
			323	6

Another very important section of the Dunkard series measured by Dr. I. C. White in Aleppo township, Greene Co., Pa. (adjoining Marshall county on the east) from the source of Dunkard fork of Wheeling creek to the mouth of Crab Apple near the Marshall-Greene county line, is given to show the presence of another coal seam (Hostetter) about midway between the Dunkard and Nineveh coals. The section is as follows:

Aleppo Township, Greene County, Pennsylvania Section.[6]

	Thickness Feet	Total Feet	
Shale and sandstones	60.0	60.0	
Limestone, Windy Gap	4.0	64.0	89′
Shale	25.0	89.0	
Coal and bituminous shale, Windy Gap	2.0	91.0	
Shale	30.0	121.0	
Sandstone, Gilmore	30.0	151.0	362′
Concealed (shale, sandstones and limestones)	300.0	451.0	

6. U. S. G. S. Bull. 65, p. 24.

	Thickness Feet	Total Feet		
Coal, Nineveh	1.0	452.0		
Shale	25.0	477.0	74′	
Limestone, Nineveh	8.0	485.0		
Shale and sandstone (Burton)	40.0	525.0		
Coal, (Hostetter) (14″)	1.2	526.2		
Limestone	2.0	528.2		
Sandstone	30.0	558.2		
Limestone	8.0	566.2	128′ 2″	
Shale and sandstone	70.0	636.2		
Limestone	2.0	638.2		
Shale	15.0	653.2		
Coal, Dunkard	2.0	655.2		
Limestone	1.5	656.7		
Shaly sandstone	25.0	681.7	30.5′	
Limestone, Jollytown	2.0	683.7		
Shale and sandstone	115.0	798.7		
Dark, calcareous shale	2.0	800.7		
Limestone	6.0	806.7		
Shale and sandstone	40.0	846.7		
Limestone	2.0	848.7	326′	
Shale and sandstone	60.0	908.7		
Shale	10.0	918.7		
Sandstone	25.0	943.7		
Shale, sandstones, and concealed	66.0	1009.7		
Coal, Washington	4.0	1013.7		
Shale and concealed	54.0	1067.7		
Coal, Waynesburg "B"	1.0	1068.7	83′	
Shale	24.0	1092.7		138′
Coal, Waynesburg "A"	0.0	1092.7		
Shale	10.0	1102.7	55′	
Sandstone, Waynesburg	45.0	1147.7		
Coal, Waynesburg				

In the above section the identifications in parentheses were inserted by the writer. It will be noted that the interval (74 ft.) of the Hostetter coal below the Nineveh coal is about the same as that given by the writer in the Burton, Wetzel county section on a preceding page.

Another section of the Dunkard series measured by Dr. G. P. Grimsley in Ohio county, W. Va., just north from the Marshall county line near Elm Grove is given. This section is important in that it shows the position of the **Elm Grove**

Limestone at its type locality as well as the intervals above the Washington coal seam of the Lower and Middle Washington limestones. The section is as follows:

County Farm, West of Elm Grove.[7]

	Ft.	In.	Ft.	In.
Sandstone shaly at top of ridge				
Shales and thin shaly sandstone layers	30			
Sandstone	2			
Shales, buff	8			
Limestone, Middle Washington	8	10	92	2
Shales	30			
Black slate	0	4		
Limestone, Lower Washington	2			
Shales	9			
Coal, Washington	2	6		
Shales, dark	15			
Limestone, nodular	3			
Shales	16			
Limestone	2			
Shales, sandy	25			
Coal blossom, Waynesburg "A"	0		103	4
Shales, buff	16			
Sandstone	0	10		
Shales, blue	8			
Limestone shaly, blue, Elm Grove	10			
Shales	5			
Waynesburg coal.				
			193	6

The Dunkard series of rocks covers almost the entire Marshall-Wetzel-Tyler area with the exception of a narrow strip extending along the Ohio river front where it has been cut away by the river and its tributaries for short distances up the latter and the lower measures exposed. The series consists of sandstones, sandy shales, limestones, limy shales and thin coal seams. The characteristic red shales appear in every section measured by the writer, and the limestones of northern Marshall county seem to change to red, marly shales with nuggets of limestone scattered through the same as one passes southwestward across Wetel and Tyler counties. It reaches its maximum thickness near Wileyville, Wetzel, 1180

7. W. Va. Geol. Survey, Ohio-Brooke-Hancock Report, page 47.

feet, as shown by the Steels Run Section on a preceding page of this report. This is also the greatest thickness yet reported for the Dunkard series in West Virginia, and in the Appalachian area.

The following sections in addition to those already given will illustrate the character of and intervals between the various formation of the Dunkard series in Marshall county:

Section East of North End of McMechen (Union District)

	Thickness Feet	Total Feet		
Sandstone and sandy shale mostly, from top of hill	45.0	45.0		
Concealed with shale and sandstones	115.0	160.0		
Sandstone, massive (old quarry), Upper Marietta ...	20.0	180.0	210.5′	
Concealed	10.0	190.0		
Sandstone, massive	10.0	200.0		
Concealed	10.0	210.0		
Slate black (6″) Washington "A"	0.5	210.5		
Concealed	5.0	215.5		
Limestone, Middle Washington.	5.0	220.5		
Shale	10.0	230.5	47′	
Concealed, sandstone and concealed	27.0	257.5		
Coal blossom, Washington	3.0	260.5		
Sandstone and concealed	20.0	280.5		
Coal blossom, Little Washington	0.5	281.0		
Concealed	5.0	286.0		
Limestone, gray	5.0	291.0	63.5′	
Concealed and massive sandstone	10.0	301.0		
Sandy shale	5.0	306.0		
Concealed and limestone.....	15.0	321.0		
Coal blossom, trace, Waynesburg "B"	0.0	321.0		98′
Concealed	15.0	336.0		
Coal blossom, trace, Waynesburg "A"	0.0	336.0		
Sandstone massive, Waynesburg	5.0	341.0	34.5′	
Concealed	7.0	348.0		
Limestone dark, flaggy, **Elm Grove**	5.0	353.0		
Shale, limy and gray	2.5	355.5		
Waynesburg coal				

The above section was measured by aneroid and possibly shows a slightly too small interval (98′) between the base of the Washington coal seam and the top of the Waynesburg which ranges usually in this region from 110′ to 120 feet. The 6″ of black slate at 210 feet from top, appears to represent the horizon of the Washington "A" coal. The Elm Grove limestone is present in typical form 2.5 feet above the base of the section.

A section measured by aneroid southwest down the hill road to Wheeling creek, 2 miles west of Majorsville, gave the following succession:

Section 2 Miles West of Majorsville (Sand Hill District)

	Thickness Feet	Total Feet		
Sandstone, concealed and shale from top of hill southwest of Golden P. O.	70.0	70.0	70′	
Limestone, light gray. 2′ | **Nineveh** Shale, limy . . . . . 7′ | **Limestone** Limestone, bluish . 1′ |	10.0	80.0		
Concealed and shale	45.0	125.0	114′	
Sandstone with shale in middle	45.0	170.0		
Shale	14.0	184.0		
Dark shale, Dunkard coal	1.0	185.0		
Shale	10.0	195.0	40′	
Sandstone, massive	20.0	215.0		
Shale	9.0	224.0		
Coal blossom, Jollytown	0.0	224.0		201′
Limestone, **Upper Washington.**	1.0	225.0		
Shale	25.0	250.0		
Sandstone	25.0	275.0		
Shale	25.0	300.0		
Sandstone	10.0	310.0		
Shale	35.0	345.0	161′	
Limestone in layers, **Middle Washington**	25.0	370.0		
Shales	9.0	379.0		
Coal blossom, double bedded, with shales between, **Washington**	6.0	385.0		

	Thickness Feet	Total Feet	
Shales	15.0	400.0	
Coal blossom, Little Washington	0.0	400.0	63′
Shale and limestone, yellowish	15.0	415.0	
Shale	30.0	445.0	
Coal blossom, Waynesburg "A"	3.0	448.0	
			115′
Limestone, brecciated	2.0	450.0	
Sandstone, (**Waynesburg**)	35.0	485.0	52′
Shale	15.0	500.0	
Waynesburg coal			

The Nineveh limestone, as well as the horizons of the Dunkard and Jollytown coals appear in the above section. The interval (161 ft.) of the latter above the Washington coal reveals a rapid thinning of the Dunkard series as compared to the same interval in the typical Dunkard creek section (see page 126) 18 miles to the southeast at which locality the Jollytown-Washington interval is given by Dr. White as 281′ 6″

A section measured by aneroid on the head of Wolf run of Wheeling creek down the hill road to the east, ¾ mile southwest of Wolf Run P. O., and joined to the log of the J. T. Cox[8] No. 1 well (M 24) gives the following succession for the Dunkard series in Webster district.

Wolf Run Section, Webster District.

	Thickness Feet	Total Feet	
Limestone, blue and hard	1.0	1.0	
Shales	50.0	51.0	51′
Coal blossom (6″) Nineveh	0.5	51.5	
Concealed	5.0	56.5	
Limestone brecciated, Concealed } **Nineveh**	15.0	71.5	
Limestone brecciated, } **Limestone**			
Red shale	60.0	131.5	
Sandstone, massive	5.0	136.5	
Concealed	15.0	151.5	
Limestone nuggets (6″)	0.5	152.0	
Shale	20.0	172.0	

8. W. Va. Geol. Survey Vol. I, p. 351.

	Thickness Feet	Total Feet	
Limestone boulders and shale.	30.0	202.0	
Sandstone, friable and concealed	55.0	257.0	
Limestone, silicious	3.0	260.0	
Unrecorded	13.0	273.0	
Sandstone, massive, **Rush Run**.	14.0	287.0.	
Shale	3.0	290.0	
Limestone, hard gray, Jollytown	5.0	295.0	156′
Shale, sandy	4.0	299.0	
Sandstone, massive	5.0	304.0	
Shale, sandy	3.0	307.0	
Slate, black .. 1-0″ } **Jollytown** **Coal, slaty** .. 0-6″ } **Coal** ...	1.5	308.5	
Fire clay and greenish shale and concealed to top J. T. Cox No 1 well	21.5	330.0	
(J. T. Cox No. 1 Record)			88′
Loam	10.0	340.0	
Gravel	5.0	345.0	
Limestone, hard	25.0	370.0	
Red rock	25.0	395.0	
Slate	30.0	425.0	165
Limestone, hard, .. } **Middle**	10.0	435.0	
Red rock ..... } **Washington**	5.0	440.0	77′
Limestone, hard, .. }	10.0	450.0	
Red rock	5.0	455.0	
Slate	15.0	470.0	
Coal, Washington	2.0	472.0	
Slate	15.0	487.0	
Bluff Sand (little water), **Mannington**	30.0	517.0	
"Break" (little gas)	13.0	530.0	148′
Slate, black	30.0	560.0	
Slate, white	10.0	570.0	
Limestone	10.0	580.0	
Slate, black	40.0	620.0	

Waynesburg coal.

The 25 feet of red rock at 370 feet from the top of the above section is generally present in the Dunkard series at 75 to 100 feet above the Washington coal. The driller has wrongly identified the Mannington sandstone, 15 feet below the Washington coal as the "Bluff" Sand, the name usually given to the Waynesburg sandstone by the oil fraternity.

A section measured by aneroid 2½ miles due east of

Moundsville along the hill road leading down Toms run of Middle Grave creek exhibited the following succession of the Dunkard series in Washington district:

Toms Run Section, 2½ Miles East of Moundsville (Washington District).

	Thickness Feet	Total Feet		
Massive Sandstone, top of hill.	5.0	5.0		
Concealed and sandstone, massive	45.0	50.0	70′	
Shale	10.0	60.0		
Limestone, gray	1.0	61.0		
Concealed and shale	9.0	70.0		
Black, bituminous slate (Nineveh coal)	1.0	71.0		
Fire clay and shale	1.0	72.0		
Limestone, gray and hard **Nineveh**	1.0	73.0		
Concealed	22.0	95.0		
Shale	25.0	120.0		
Concealed, mostly shale	40.0	160.0		
Sandy shale	15.0	175.0	265′	
Sandstone, massive and sandy shale	45.0	220.0		
Sandstone, massive, friable	20.0	240.0		
Sandy shale	25.0	265.0		
Concealed, sandstone and concealed	35.0	300.0		319
Sandy shale and sandstone, friable	30.0	330.0		
Sandstone, massive, Marietta	5.0	335.0		
Coal blossom, Washington "A"	0.0	335.0		
Shale and concealed	9.0	344.0		
Limestone, gray, Middle Washington	1.0	345.0	54′	
Shale, sandy	19.0	364.0		
Concealed, shale and sandstone	25.0	389.0		
Coal, slaty, Washington	1.0	390.0		
Shales and concealed	24.0	414.0		
Coal blossom, Little Washington	0.0	414.0	59′	
Shale and concealed	15.0	429.0		
Sandstone	5.0	433.0		

		Thickness Feet	Total Feet		
Coal blossom, trace,					117.5′
Waynesburg "B"		0.0	433.0		
Sandy shale		15.0	448.0		
Coal blossom, Waynesburg "A"		0.0	448.0		
Concealed		40.0	488.0		
Sandstone, massive		6.0	494.0		
Shale, sandy		8.0	502.0		
Limestone, black flaggy .... 1.5′	**Elm Grove**			58.5′	
Limestone, gray 2.0	**Limestone**	3.5	505.5		
Limy shale		1.0	506.5		

Waynesburg coal.

The Jollytown and Dunkard coals were not observed in the above section.

A section measured by hand level southwest down hill road to Glen Easton on the main line of the Baltimore & Ohio R. R. gave the following exposures for the Dunkard series in Cameron district:

Glen Easton Section (Cameron District).

		Thickness Feet	Total Feet		
1	Concealed and shale, from top of hill	20.0	20.0	.45′ (1364 L—A. T)	
2	Massive Sandstone and shale	24.0	44.0		
3	Coal blossom	1.0	45.0		
4	Concealed	5.0	50.0		
5	**Limestone, blue and hard.**	0.5	50.5		
6	Sandy shale	18.8	69.3		
7	Concealed with shale and sandstone in middle	39.6	108.9	65.9′	
8	**Limestone, gray and hard.**	2.0	110.9		
9	Concealed and sandstone.	17.4	128.3		
10	Sandy shale	20.8	149.1		
11	Sandstone, weathering rounded	1.0	150.1		
12	Sandstone and concealed	54.2	204.3		345.9′
13	Sandstone, massive	7.2	211.5		
14	Concealed	83.2	294.7	250.4′	
15	Sandstone, flaggy	15.6	310.3		
16	Concealed	15.6	325.9		
17	Shale and sandstone	5.2	331.1		

		Thickness Feet	Total Feet		
18	Sandstone, friable and sandy shale	20.8	351.9		
19	Concealed	8.4	360.3		
20	**Coal blossom, Dunkard**	1.0	361.3		
21	Limestone, blue and hard.	1.0	362.3		
22	Concealed and shale	28.0	390.3	29.6′	
23	**Slate, black (Jollytown coal)**	0.6	390.9		
24	Concealed	8.0	398.9		
25	**Limestone, blue and hard, Upper Washington**	2.0	400.9		
26	Concealed	3.0	403.9		
27	Shale, red	1.2	405.1	28.6′	
28	Sandstone, massive	3.0	408.1		
29	Sandstone, friable and sandy shale	11.4	419.5		243.6′
30	Concealed to fork of road, Glen Easton	15.5	435.0		
31	Unrecorded	215.0	650.0	215′	
32	**Coal, Washington**	0.0	650.0	120′	
33	Unrecorded	120.0	770.0		
34	**Waynesburg coal.**				

In the above section, formations Nos. 1-30 inclusive were measured from exposures by hand level, but Nos. 31 to 34 were supplied from the record of the Mary V. Wilson No. 1 well (M 39), 7-10 mile southwest of Glen Easton station, from which record the tidal elevation of the roof of the Waynesburg coal was figured at 630′ A. T. The Nineveh coal horizon evidently belongs in the 83.2 ft. of concealed interval or No. 13 of section. The interval (243.6′) between the Washington and Jollytown coals is only 35 to 40 feet less than the same given in the typical Dunkard creek section, 14 miles to the southeast.

A section of the Dunkard series measured southeast along road from the top of the highest Knob in Marshall county, located ½ mile due south of Rocklick post office in the northeast portion of Cameron district gave the following exposures:

Rocklick Section, (Cameron District).

	Thickness Feet	Total Feet	
(Top of Knob—1590′ A. T.)			
Sandstone and concealed from top of knob to road	54.0	54.0	
Concealed and massive sandstone	15.0	69.0	
Shale	10.0	79.0	120′
Sandstone, massive, **Taylor** ...	30.0	109.0	
Concealed	10.0	119.0	
Limestone, gray and hard, visible 12″	1.0	120.0	
Concealed	15.0	135.0	
Coal blossom	0.0	135.0	
Concealed	40.0	175.0	76′
Black slaty blossom	0.0	175.0	
Sandstone, concealed and shale	21.0	196.0	
Coal, slaty, impure (9″) Nineveh	1.0	197.0	
Sandstone, friable	5.0	202.0	
Sandy shale	5.0	207.0	
Shale	10.0	217.0	220′
Limestone, visible, **Nineveh**	1.0	218.0	
Concealed, to Cross-roads	48.0	266.0	
(U. S. 1324′ A. T.)			
Unrecorded	150.0	416.0	
Black slate, **Jollytown coal** ..	0.0	416.0	
Limestone, blue and hard, Middle Washington to 5′ below top of Silas Archer well No. 1 (M 38)	1.0	417.0	346′
Unrecorded in well, about.....	345.0	762.0	
Waynesburg coal			

A new coal seam, about 60 feet above the Nineveh coal, appears in this section. It is not very persistent however since it was not noted by the writer in any other region of the three counties.

A section measured by aneroid northwest down the hill road, ½ mile southeast of Cameron, in Liberty district, to the Lee Howard gas well gave the following for the Dunkard series:

Section One-half Mile Southeast of Cameron (Liberty District)

		Thickness Feet	Total Feet	
1	Shale and sandstone	20.0	20.0	
2	Reds and shale	27.0	47.0	50′
3	Concealed	3.0	50.0	
4	**Coaly shale and fire clay,.**	0.0	50.0	
5	Flaggy sandstone and sandy shale	10.0	60.0	70′
6	Concealed	30.0	90.0	
7	Shale	15.0	105.0	
8	Sandstone	15.0	120.0	
9	**Coaly shale** (2″).....	0.0	120.0	
10	Concealed and shale	20.0	140.0	
11	Black slate (2″)	0.0	140.0	100′
12	Concealed, mostly shale ..	35.0	175.0	
13	Concealed	45.0	220.0	
14	(Fire clay 6″ } **Nineveh** 8″ to....	1.0	221.0	
15	Coal .. (2″) } **Coal**			
16	Concealed	10.0	231.0	
17	Shale, variegated and thin sandstones	25.0	256.0	
18	Concealed	15.0	271.0	
19	Sandstone	10.0	281.0	220′
20	Concealed	20.0	301.0	
21	Shale, variegated	5.0	306.0	
22	Sandstone and shale.....	25.0	331.0	
23	Concealed	15.0	346.0	
24	Sandstone	5.0	351.0	
25	Concealed to top of Lee Howard gas well.....	24.0	375.0	
26	Unrecorded	65.0	440.0	
27	**Coal, Jollytown**	0.0	440.0	
28	Unrecorded	240.0	680.0	
29	**Coal, Washington**	0.0	680.0	360′
30	Unrecorded	120.0	800.0	
31	**Waynesburg coal.**			

In the above section, formations Nos. 1-25 inclusive were measured from exposures, and Nos. 26-31 inclusive from oil well records in the vicinity. At the point where the exposed portion was measured the rocks are pitching to the southeast so that the intervals show less than they really are. In this section the interval of the Windy Gap coal above the base of the Dunkard series is 750 feet, while in the Glen Easton section (see page 136) the same interval was 725 feet.

The following detailed section of the Dunkard series was made by Dr. I. C. White at Boardtree in the southeast corner of Liberty district:

Boardtree Section[9] (Liberty District)

	Thickness Feet	Total Feet		
Sandstone, gray and concealed.	55.0	55.0	55′	
Limestone, gray, Windy Gap..	5.0	60.0	105′	
Red shale and concealed.....	100.0	160.0		
Coaly slate (13″).....	1.0	161.0		
Concealed to base of sandstone, massive	35.0	196.0		
Concealed, sandstone, and red **shale** to Boardtree Tunnel..	175.0	371.0	251′	
Sandy shale	15.0	386.0		
Sandstone, **Nineveh**	15.0	401.0		
Coal, Nineveh	1.0	402.0		662′
Gray shale	15.0	417.0		
Sandstone, massive	12.0	429.0		
Shale	3.0	432.0		
Limestone ... 1′ } **Nineveh**				
Black slate .. 3′ }	19.0	451.0		
Limestone and limy beds 15′ } **Limestone**				
Variegated shale	9.0	460.0		
Sandstone	5.0	465.0		
Shale, limy	7.0	472.0	261′	
Sandstone, to level of track at west portal	5.0	477.0		
Concealed, shale and sandstone	100.0	577.0		
Massive sandstone, **Rush Run**..	30.0	607.0		
Shale	3.0	610.0		
Coal, Dunkard to level of bore hole	2.0	612.0		
Interval, shale, sandstones and limestones with 2 thin **coal beds**	50.0	662.0		
Shale, sandstone and red beds..	300.0	962.0		
Coal, Washington	5.0	967.0	455′	
Shales, limestones and sandstone **Waynesburg coal.**	150.0	1117.0		

9. W. Va. Geol. Survey, Vol. II, pp. 103-104.

A section measured by aneroid from the top of a high knob, located 1 mile southwest of Bellton (Denver Sta.), southwest down hill road leading to Bannen post office gave the following exposures for the Dunkard series:

Section One Mile Southwest of Bellton (Liberty District).

	Thickness Feet	Total Feet	
Concealed from otp of knob...	80.0	80.0	
Shale, sandstone and concealed	20.0	100.0	101'
Limestone, blue and hard....	1.0	101.0	
Concealed with shale and thin sandstones	49.0	150.0	
Dark shale (2") and fire clay..	0.0	150.0	
Sandstone, massive **Gilmore (?)**	50.0	200.0	
Concealed	10.0	210.0	209'
Sandstone, friable and shale..	20.0	230.0	
Massive sandstone, **Nineveh..**	75.0	305.0	
Shale	5.0	310.0	
Coaly shale (3") Nineveh.....	0.0	310.0	
Shale	25.0	335.0	
Limestone, dark, silicious.....	0.5	335.5	
Black slate	5.0	340.5	
Coal slaty (6")	0.5	341.0	
Limestone, gray and hard, Nineveh	10.0	351.0	70'
Slate, black with streaks of coal and fossil plant stems.....	2.0	353.0	
Coal, good, 8".....	1.0	354.0	
Concealed	26.0	380.0	
Coal (8") Hostetter.....	1.0	381.0	
Fire clay and shale.....	9.0	390.0	
Concealed	5.0	395.0	
Shale and sandstone	10.0	405.0	
Concealed	5.0	410.0	
Sandstone and shale.....	30.0	440.0	128'
Concealed, sandstone and concealed	30.0	470.0	
Sandstone and shale	15.0	485.0	
Concealed	20.0	505.0	
Red limy shale.....	3.0	508.0	
Limestone, gray and hard, silicious	2.0	510.0	
Concealed	5.0	515.0	
Sandstone	8.0	523.0	122'
Shale	7.0	530.0	
Concealed, shale and sandstone	100.0	630.0	

		Thickness Feet	Total Feet	
Black slate 0′ 2″ Coal .... 0′ 3″ Shale, gray 0′ 0″½ Coal .... 0′ 1″	**Dunkard** 0′ 6½″ **Coal**	0.5	630.5	
Fire clay		0.5	631.0	71′
Concealed		45.0	676.0	
Red limy shale		10.0	686.0	
Limestone and concealed		15.0	701.0	
Coal, (old opening) Jollytown. (W. V. Hoge No. 2 Record).		1.0	702.0	
Unrecorded in well		215.0	917.0	
Coal, Washington		0.0	917.0	330′
Unrecorded		115.0	1032.0	
Coal, Waynesburg.				

A portion of a section in the vicinity of Bellton, (Denver Station), 3 miles northwest from Boardtree, measured by Dr. I. C. White,[10] in conjunction with data supplied by the writer and the record of the Marshall County Bank well No. 1 (M121) gives the following succession for the Dunkard series:

Bellton Section (Liberty District).

		Thickness Feet	Total Feet	
1	**Limestone, Windy Gap...**	5.0	5.0	
2	Shale	30.0	35.0	35′
3	**Coal blossom, Windy Gap.**	0.0	35.0	
4	Concealed, sandstone and shale	30.0	65.0	
5	Shale and sandstone.....	60.0	125.0	
6	Sandstone, massive, gray..	20.0	145.0	
7	Red shale and concealed..	75.0	220.0	298′
8	**Sandstone, massive**	40.0	260.0	
9	Red shale and sandstone..	50.0	310.0	
10	Limestone	3.0	313.0	
11	Shale and concealed	20.0	333.0	
12	**Coal, Nineveh**	1.0	334.0	
13	Shale and sandstone.....	35.0	369.0	
14	**Limestone, Nineveh**	10.0	379.0	
15	Shale, sandstone and concealed	100.0	479.0	161.5′
16	Sandstone	5.0	484.0	
17	Shale	10.0	494.0	
18	Limestone (6″)	0.5	494.5	

10. Vol. II, pp. 104-105, W. Va. Geol. Survey.

		Thickness Feet	Total Feet	
19	**Coal (3″) Fish Creek**.....	0.3	494.8	
20	Shale and sandstone.....	15.0	509.8	
21	Red shale	5.0	514.8	40.3′
22	Concealed	20.0	534.8	
23	**Coal, Dunkard**	1.0	535.8	
24	Shale and concealed.....	30.0	565.8	31.0′
25	**Coal, Jollytown (13″)**....	1.2	567.0	
26	Shales, limy	10.0	577.0	
27	Limestone, Upper Washington ..... (Marshall County Bank Well No. 1 Record).	4.0	581.0	327.2′
28	Unrecorded	312.0	893.0	
29	**Waynesburg Coal.**			

In the above section formations Nos. 24-29 inclusive were added by the writer. It is very evident that the well record used by Dr. White in completing the original Bellton section was erroneous in that the interval from the Jollytown to the Waynesburg coal seam is over 100 feet too great. This interval in the Sarah Anderson No. 1 well (W 1) northeast of Burton, Wetzel county, is only 380 feet, while the original Bellton section gives the same interval as 461 feet. The above section as corrected shows this interval over 50 feet less than at Burton which is the result expected in this distance to the northwest.

A section measured by aneroid southeast down the hill road from Rosbys Rock gave the following succession for the Dunkard series:

Rosbys Rock Section, Meade District.

	Thickness Feet	Total Feet	
Sandstone and shale from top of hill anl level of Gorby Hrs. No. 1 well (M 43).....	15.0	15.0	16′
Limestone, gray and hard with dark shale over, Windy Gap..	1.0	16.0	

	Thickness Feet	Total Feet		
Concealed	9.0	25.0		
Shale, sandstone and shale	10.0	35.0		
Concealed	8.0	43.0		
Red shale and sandstone friable (and check on U. S. 1337)	7.0	50.0		
Concealed and sandstone	31.0	81.0		
Concealed and shale	4.0	85.0		
Sandstone and concealed	10.0	95.0		
Red, limy shale	5.0	100.0		
Sandy shale	18.0	118.0		
Sandstone, flaggy	2.0	120.0	196′	
Concealed	25.0	145.0		
Sandstone and thin **limestones, silicious**	5.0	150.0		
Concealed	20.0	170.0		
Sandstone and shale	10.0	180.0		
Concealed	5.0	185.0		
Sandstone, friable	15.0	200.0		
Red shale	10.0	210.0		
Limestone, blue and hard, Nineveh	2.0	212.0		
Shale, dark, limy	8.0	220.0		430′
Concealed	10.0	230.0		
Massive sandstone	15.0	245.0	38′	
Sandy shale	4.0	249.0		
Limestone, blue and hard (at water trough)	1.0	250.0		
Shale	25.0	275.0		
Concealed	10.0	285.0		
Sandy shale	10.0	295.0		
Sandstone, massive	5.0	300.0		
Shale	20.0	320.0		
Sandstone, massive, friable at top	15.0	335.0		
Shale	15.0	350.0		
Sandstone, flaggy	20.0	370.0	180′	
Sandy shale with thin sandstones	30.0	400.0		
Limestone, silicious, Jollytown	2.0	402.0		
Sandy shale	3.0	405.0		
Red shale	5.0	410.0		
Sandstone, friable, **Jollytown**	10.0	420.0		
Sandy shale	9.5	429.5		
Coal, slaty (6″), Jollytown	0.5	430.0		

	Thickness Feet	Total Feet		
Black slate and shale.....	7.0	437.0		
Sandstone, friable	3.0	440.0		
Buff shale	4.7	444.7		
Limestone, gray and hard, Upper Washington	0.3	445.0		
Shale, buff	5.0	450.0		
Concealed, sandstone, and concealed	10.0	460.0		
Dark red shale	5.0	465.0		
Buff shale	9.0	474.0	146.4′	
Sandstone	2.0	476.0		
Shale	4.0	480.0		
Concealed and sandstone.....	88.0	568.0		
Sandy shale	1.5	569.5		
Limestone, **Lower Washington.**	0.5	570.0		232.4
Black slate and shale.....	3.0	573.0		
Coal, slaty, 20″ **Shale .... 12″ } Washington..** **Coal, slaty 9″**	3.4	576.4		
Unrecorded in Gorby Heirs No. 1 well	86.0	662.4	86′	

Waynesburg coal.

The above section was measured down the dip of the rocks and necessarily the intervals show shorter than they should be. The total dip is about 60 feet as shown by the elevation of the Pittsburg coal seam in oil wells (M 42 and 43).

A section measured by aneroid southwest down hill road leading to mouth of Hog Run from the top of a high Knob located 2 miles northeast from Powhatan station, gave the following exposures for the Dunkard series in the southwest corner of Clay district:

Hog Run Section (Clay District).

	Thickness Feet	Total Feet		
Concealed and sandstone from top of knob.....	20.0	20.0	55′	
Massive sandstone	30.0	50.0		
Limestone, blue and hard....	5.0	55.0		100′
Concealed	34.0	89.0		
Limestone, blue and hard.....	1.0	90.0	45′	
Concealed	10.0	100.0		

		Thickness Feet	Total Feet		
Limestone, blue and hard, interstratified with dark shale		20.0	120.0		
Concealed		10.0	130.0	120′	
Sandy shale		15.0	145.0		
Red shale and concealed		75.0	220.0		
Limestone, gray and silicious	**Nineveh**	1.0	221.0		
Shale, sandy and red		14.0	235.0		
Limestone, blue and hard	**Limestone**	10.0	245.0		
Concealed		10.0	255.0		
Sandy shale		15.0	270.0		
Red shale with limestone nuggets		15.0	285.0		
Concealed, sandstone, and concealed		50.0	335.0	310′	
Flaggy sandstone and shale		35.0	370.0		
Massive sandstone		10.0	380.0		
Concealed		50.0	430.0		
Massive sandstone		20.0	450.0		
Shale		35.0	485.0		
Limestone, yellowish, **Middle Washington**		10.0	495.0		
Concealed		15.0	510.0		
Limestone and concealed		20.0	530.0		
Coal blossom, Washington		0.0	530.0		
Concealed		20.0	550.0		
Coal, blossom, Little Washington		0.0	550.0	67′	
Concealed		10.0	560.0		
Sandstone and shale		37.0	597.0		100′
Coal blossom, Waynesburg "A"		3.0	600.0		
Concealed		20.0	620.0	33′	
Sandy shale		10.0	630.0		
Waynesburg Coal.					

The 5 feet of limestone 50 feet from the top of the section may represent the **Windy Gap** and if so the interval between it and the **Nineveh limestone** (135 feet) has thinned down from about 325, the same as found in the West P. O. Section on a subsequent page. The air line distance of the latter place from the mouth of Hog Run is about 14 miles to the southeast. The measures below the Nineveh limestone do not thin nearly so rapidly as the above rate would represent, so that it is quite doubtful whether the above mentioned 5 feet of limestone represents the Windy Gap. Two or three

limestones appear in the 250 to 300 feet of measures between the Nineveh and Windy Gap coals, none of which seems very persistent.

A section measured by barometer northwest down hill road leading to mouth of Sims Run at the Ohio river, ⅔ mile north of Clarington station, Franklin district, gave the following succession for the Dunkard series:

Sims Run Section (Franklin District), ⅔ Mile N. of Clarington.

	Thickness Feet	Total Feet		
Concealed, sandstone and shale from top of knob	40.0	40.0		
Massive sandstone	15.0	55.0	75′	
Concealed	19.0	74.0		
Limestone gray and hard Windy Gap	1.0	75.0		
Coaly blossom, Windy Gap	0.0	75.0		
Concealed	30.0	105.0		
Sandstone and sandy shale	10.0	115.0		
Limestone boulders and limy shale	10.0	125.0	75′	
Buff sandy shale	24.0	149.0		
Shale, black (10″)	1.0	150.0		
Fire clay, limestone and limy shale	5.0	155.0		194′
Sandstone, friable	20.0	175.0		
Fire clay, horizon	0.0	175.0		
Red and variegated shale	15.0	190.0		
Concealed	10.0	200.0		
Variegated and red shale	10.0	210.0	119′	
Sandstone and shale	8.0	218.0		
Fire clay horizon	2.0	220.0		
Sandstone, massive	15.0	235.0		
Concealed	20.0	255.0		
Massive sandstone and shale	10.0	265.0		
Concealed	4.0	269.0		
Limestone, blue and hard, Nineveh	1.0	270.0		
Red shale	30.0	300.0		
Sandstone, yellowish	5.0	305.0	95.5′	
Concealed	10.0	315.0		
Red and buff shale	20.0	335.0		
Sandstone, friable, Burton	25.0	360.0		138.5
Shale and concealed	4.5	364.5		
Slate, black, Dunkard Coal (?)	0.5	365.0		
Concealed	30.0	395.0	43′	
Sandstone	10.0	405.0		
Shale	2.5	407.5		

	Thickness Feet	Total Feet		
Dark shale and fire clay, Jollytown (?)	0.5	408.0		
Soft red shale	1.0	409.0		
Dark shale and fire clay	1.0	410.0		
Sandstone, friable and shale	15.0	425.0		
Concealed, shale and concealed	30.0	455.0		
Massive sandstone	20.0	475.0		
Sandy shale	17.0	492.0	142.2′	
Fire clay horizon	1.0	493.0		
Sandstone, massive	7.0	500.0		
Concealed	3.0	503.0		
Limestone, gray, Middle Washington	2.0	505.0		
Concealed	20.0	525.0		
Massive sandstone	15.0	540.0		
Concealed	9.7	549.7		256.5′
Coal blossom (visible 3″) Washington Coal	0.3	550.0		
Concealed	20.0	570.0		
Sandstone with shale layers	15.0	585.0		
Sandy and variegated shale	30.0	615.0		
Massive sandstone	13.0	628.0		
Shale, gray	2.0	630.0	114.3′	
Coal, Waynesburg "A"	3.5	633.5		
Limestone, yellowish	1.0	634.5		
Shale	15.5	630.0		
Concealed	14.0	664.0		
Waynesburg Coal.				

Some sections of the Dunkard series in Wetzel county will now be given.

A section measured by hand level from the top of a high knob located ¾ mile due south of Littleton, Clay district, northeast down hill road to mouth of Long Drain gave the following for the Dunkard series:

Littleton Section (Clay District).

	Thickness Feet	Total Feet	
Concealed, sandstone and sandy shale from level of Geo. N. Gillingham No. 1 well (W 56) to summit of hill road (U. S. 1406′ A. T.)	46.0	46.0	173′
Sandstone and sandy shale	14.5	60.5	
Black slate	0.5	61.0	
Mostly concealed, shale and sandstone	112.0	173.0	
Black blossom, Nineveh coal	0.0	173.0	

	Thickness Feet	Total Feet	
Sandstone and sandy shale...	12.0	185.0	
Black bituminous shale (1267 A. T.)	0.3	185.3	
Shale, limy	2.0	187.3	
Limestone, gray and hard, silicious	4.0	191.3	
Shale, limy ..... Nineveh..	2.5	193.8	59.9′
Limestone, gray and hard, silicious	0.5	194.3	
Variegated and red sandy shale	38.6	232.9	
Fire clay, Hostetter coal horizon	0.0	232.9	
Sandy and red shale and concealed	17.6	250.5	
Sandstone, friable and concealed	26.0	276.5	
Buff sandy shale	10.4	286.9	
Red and sandy shale	20.8	307.7	
Massive sandstone (quarry rock) **Fish Creek**	35.0	342.7	114.4′
Shale	3.6	346.3	
Coal .....0′ 5″ **(Fish Creek)**			
Slate, gray ..0 1 (1100′			
Coal .....0 6 A. T.) ..	1.0	347.3	
Fire clay and sandstone, friable	12.4	359.7	
Concealed and red shale	20.8	380.5	
Sandy shale with thin sandstones	15.6	396.1	
Sandstone, friable **(Rush Run)**	10.6	406.7	65.1′
Sandy shale	5.0	411.7	
Coal .....0′ 4″			
Shale, gray ..0 2 **Dunkard.**	0.7	412.4	
Coal .....0 2 (1034′ A. T.)			
Shale, sandy, red and variegated	41.0	453.4	
Sandstone, friable, **(Jollytown)**	10.0	463.4	52′
Black slate, Jollytown Coal (982′ A. T.).....	1.0	464.4	
Limestone, gray and silicious, Upper Washington	2.5	466.9	
Shale, limy	5.5	472.4	
Sandstone, friable, and sandy shale **(Hundred Sandstone)** to R. R. east end Martin tunnel (952 A. T.)	22.0	494.4	50′
Concealed	19.7	514.1	
Coal (Hundred)	0.3	514.4	

	Thickness Feet	Total Feet	
Unrecorded in well (W 56) ..	200.6	715.0	200.6′
Coal, Washington, supplied ...	0.0	715.0	
Unrecorded	125.0	840.0	125′

Waynesburg coal

The names in parentheses in this section are new terms for formations of the Dunkard series. It appears that the coal at the base of the great Fish Creek sandstone of Stevenson is not the Dunkard as heretofore supposed, but another that comes 65 feet higher in the measures which the writer has termed the **Fish Creek coal,** since it has been mined for domestic use on the Pennsylvania fork of this stream below Deep Valley, Pa., and is almost one foot thick on the W. Va. fork of the same stream at Littleton, Wetzel Co., W. Va., where it is 840 feet above the top of the Pittsburg coal. One mile west of Deep Valley this same interval is 835′ to 840 feet. The **Dunkard** coal at its type locality on the head of Dunkard creek comes only 750 feet above the top of the Pittsburg coal, and at Hundred and Littleton this same interval is 770 and 774 feet respectively where it is positively identified in both places by the Jollytown coal 50 feet lower in the measures along with the Upper Washington limestone, 3 to 4 feet in thickness directly under the latter coal.

Another new coal also makes its appearance in the above section. The writer has named it the **Hundred coal** from a town of that name, located three miles southeast of Littleton, a short distance west of which its crop is exposed at the base of the great **Hundred sandstone.**

A section measured by aneroid northeast down the hill road to near the mouth of Morgan Run at Smithfield, Grant district, Wetzel county, gave the following exposures for the Dunkard series:

Smithfield Section, Grant District, Wetzel County.

		Thickness Feet	Total Feet	
	Gilmore			
1	**Mostly sandstone** and concealed, from top of high knob (1557′ A. T.) ..	115.0	115.0	115′
2	**Fire clay horizon**	0.0	115.0	
3	Concealed	9.0	124.0	
4	**Sandstone, interstratified with shale, Nineveh** ..	72.0	196.0	81′
5	Shale, red and sandy	45.0	241.0	
6	Concealed and reds	55.0	296.0	
7	Sandstone and shale	18.0	314.0	
8	Concealed	50.0	364.0	218′
9	**Massive sandstone, Fish Creek**	50.0	414.0	
10	Concealed	9.0	423.0	
11	Sandstone, flaggy top, friable at bottom	9.0	432.0	
12	Concealed	13.0	445.0	
13	Sandstone, friable, **Rush Run**	22.0	467.0	112′
14	Concealed and reds	14.0	481.0	
15	**Sandstone, massive, coarse, Jollytown**	45.0	526.0	
16	**Coal blossom (4″), Jollytown**	0.0	526.0	
17	Concealed, shale and concealed	32.0	558.0	
18	Sandstone, friable	23.0	581.0	
19	Concealed	4.0	585.0	
20	Sandstone and shale	35.0	620.0	
21	Concealed and shale.....	22.0	642.0	184′
22	Sandstone, massive	18.0	660.0	
23	Shale	5.0	665.0	
24	Concealed to Fishing creek just below mouth of Morgan run 830 A. T...	45.0	710.0	
25	Unrecorded	215.0	925.0	215′
26	**Waynesburg coal horizon**			

In this section formations Nos. 1-24 inclusive are from exposures, but Nos. 25 and 26 are supplied by the writer on the assumption that the top of the Pitsburg coal seam is 240′ A. T. which almost agrees with its elevation in oil well

W 160 nearly a mile northeast. Five great sandstones; viz., Jollytown, Rush Run, Fish Creek, Nineveh and Gilmore, all seem to appear at their proper horizons. In the Arches Fork section, published on page 108 of this report, the Washington coal seam comes 145 feet above the Waynesburg coal, so that in the above section the interval between the Jollytown and Washington coals is about 255 feet, or exactly the same as in the Sarah Anderson No. 1 oil well northeast from Burton, Church district, Wetzel Co. The Jollytown, Dunkard, Hostetter and Nineveh coals appear to become thin and unimportant southwest from Fishing creek.

A section measured by aneroid down the hill west to Piney on Piney fork of Fishing creek gives the following exposures for the Dunkard series in Green district, Wetzel Co..

Piney Section, Green District, Wetzel County

	Thickness Feet	Total Feet	
Concealed from top of hill ..	95.0	95.0	
Sandstone, coarse, Gilmore ..	15.0	110.0	150′
Shale, with thin sandstones ..	40.0	150.0	
Limestone, blue and hard	1.0	151.0	
Shale, red and buff	24.0	175.0	
Sandstone	15.0	190.0	
Concealed and shale	10.0	200.0	100′
Sandstone, flaggy top, massive and coarse at bottom, Nineveh	50.0	250.0	
Reds and concealed	15.0	265.0	
Sandstone, brown and friable, Fish Creek	25.0	290.0	40′
Reds and concealed	85.0	375.0	
Reds	5.0	380.0	
Sandstone and sandy shale, **Rush Run**	35.0	415.0	140′
Shale	14.0	429.0	
Black bituminous shale and fire Clay, Dunkard coal?.....	1.0	430.0	
Shale	10.0	440.0	
Sandstone	10.0	450.0	
Shale	15.0	465.0	90′
Sandstone, massive, Jollytown.	50.0	515.0	
Shale	5.0	520.0	

	Thickness Feet	Total Feet	
Coal (2″), Jollytown	0.0	520.0	
Shale	5.0	525.0	
Concealed and massive sandstone to Piney fork and bench mark U. S. 790 A. T. at Piney	65.0	590.0	70′

At Piney the top of the Pittsburg coal is 235′ A. T. as shown by wells W 239 and W 240. This would make the Jollytown-Pittsburg coal interval 625 feet. The Jollytown sandstone above the Jollytown coal has developed into a great cliff similar to its outcrop on Fish creek, below Hundred, Wetzel Co., where it was named by the writer as the sandstone between the Dunkard and Jollytown coal seams. The Nineveh is also a very massive sandstone as in the Smithfield section. The interval, 90 feet, between the Jollytown and Dunkard coal seams appears excessive, but at Littleton and Hundred it is 55 and 65 feet respectively.

Another section measured by aneroid in the northeast corner of Green district, Wetzel Co., down the hill road southeast of Brown P. O., and joined to the log of the Brown core test (W 228) near the head of Shenango creek, exhibits the following succession for the Dunkard series:

Brown P. O. (Shenango Creek) Section, Green District, Wetzel County.

		Thickness Feet	Total Feet	
1	Concealed from top of knob to fork of road at Brown P. O. on ridge	80.0	80.0	130′
2	Shale, sandy and red with thin sandstones	30.0	110.0	
3	**Sandstone, massive, Taylor**	20.0	130.0	
4	Concealed	55.0	185.0	65′
5	**Sandstone, Nineveh**	10.0	195.0	
6	Concealed, reds and concealed	45.0	240.0	
7	Buff shale	5.0	245.0	
8	Massive sandstone and shale	40.0	285.0	145′
9	Sandstone, massive, coarse, gray, forming cliff	25.0	310.0	
10	**Shale and massive sandstone, coarse, Fish Creek sandstone**	30.0	340.0	

		Thickness Feet	Total Feet		
11	Red and sandy shale ..	5.0	345.0		
12	Concealed and sandy shale	25.0	370.0		
13	Red and buff shale	10.0	380.0	40.5′	
14	**Coal (6), Fish Creek?**	0.5	380.5		
15	Limestone, silicious	1.0	381.5		
16	Unrecorded to top Brown core test	183.5	565.0		
	Brown Core Test Record (Authority: S. W. Meals, Moundsville, W. Va.)			226.5′	
17	Unrecorded	40.0	605.0		315′
18	**Coal, Washington "A"** ..	1.5	606.5		
19	Unrecorded	88.5	695.0	88.5′	
20	**Coal, Washington**	2.0	697.0	142′	
21	Unrecorded	140.0	837.0		
22	Unrecorded	60.0	897.0	64′	
23	**Coal, Uniontown**	4.0	901.0		
24	Unrecorded	94.0	995.0		
25	Black shell	0.0	995.0	194′	
26	Unrecorded to bottom of hole	100.0	1095.0		

In this section only formations Nos. 1-21 inclusive, 837 feet from the top, are contained in the Dunkard series. Nos. 22-26 are given to show the rest of the core test and also the position of the Washington coal with respect to the Uniontown coal, as the Waynesburg seam was not noted. The Washington "A" coal appears in good thickness in the section, 88½ feet above the Washington coal.

A section measured by aneroid northwest down hill road from the top of a high knob located 1 mile southeast of West P. O., on head of Middle Fork of Lynn Camp run, Proctor district, gave the following succession for the Dunkard series:

Section at West P. O. (Proctor District).

		Thickness Feet	Total Feet	
Sandy shale from top of knob	.....	15.0	15.0	
Sandstone and concealed to bench	.....	50.0	65.0	
Concealed mostly sandstone to bench	Proctor sandstones	30.0	95.0	151′
Concealed, mostly sandstone with steep bluff	.....	55.0	150.0	
Limestone, gray and hard, Windy Gap		1.0	151.0	

	Thickness Feet	Total Feet		
Coal, slaty (8″), Windy Gap	1.0	152.0		
Limy shale, concealed and flaggy sandstone	10.0	162.0	51′	
Concealed and shale	40.0	202.0		
Limestone, gray and hard	1.0	203.0		
Shale, sandy	2.0	205.0	17′	
Concealed	14.0	219.0		
Limestone, dark gray	1.0	220.0		
Concealed and sandstone	10.0	230.0		
Red shale	20.0	250.0	61′	
Concealed, mostly sandstone, **Gilmore**	30.0	280.0		
Shale, variegated with 2 thin sandstones	50.0	330.0		326′
Concealed	55.0	385.0		
Flaggy sandstone and concealed	10.0	395.0	149′	
Sandstone, massive, coarse, **Taylor**	20.0	415.0		
Concealed, sandstone and shale	14.0	429.0		
Limestone, gray and hard	1.0	430.0		
Concealed	5.0	435.0		
Sandstone and concealed	20.0	455.0	48′	
Sandstone, flaggy at bottom, **Nineveh**	20.0	475.0		
Shale	2.0	477.0		
Coal, Nineveh (1090′ L—A. T.)	0.5	477.5		
Black slate and flaggy sandstone	4.0	481.5		
Limestone, gray and hard, silicious, Nineveh to creek	8.5	490.0	653′	
Interval, supplied from average intervals between Wileyville and Denver	640.0	1130.0		
Waynesburg coal				

This is a very important section in that an almost vertical measurement is obtained for interval (326 feet) from the Nineveh up to the Windy Gap coal. This is the only exposure of the latter seam found by the writer in either Wetzel or Tyler. It is important for the reason that it shows that this latter seam comes 128 feet above the base of the Gilmore sandstone. In this interval are found 2 limestones, each 1 foot thick and 16 feet apart, the lower of which comes 60 feet

above the base of the Gilmore sandstone. Another limestone appears in the section, 47′ above the Nineveh coal. There also appears to be 150 feet of measures on above the Windy Gap limestone, that are mostly made up of great sandstone masses. The Nineveh limestone is present in good thickness, as well as the Nineveh, Taylor and Gilmore sandstones. The interval from the Nineveh coal up to the base of the Gilmore sandstone is 197 feet. Near the head of Taylor run in Gilmore township, Greene Co., Pa., where this great sandstone is in typical development, this same interval is 215 feet.

A section measured by aneroid down the Ohio river hill one mile northeast of Steelton gave the following for the Dunkard series in the extreme northern portion of Magnolia district, Wetzel Co.:

Section One Mile Northeast of Steelton, Magnolia District.

	Thickness Feet	Total Feet		
Unrecorded from top of knob to bench or flat	265.0	265.0		
Sandstone, friable	25.0	290.0	325′	
Concealed	25.0	315.0		
Massive sandstone, **Fish Creek**	10.0	325.0		
Shale, gray at top, sandy in middle and red at bottom	50.0	375.0		
Massive sandstone, **Jollytown**	10.0	385.0		
Shale, variegated and red	17.0	402.0	85′	
Sandstone, friable and shale	7.0	409.0		
Coal 0′ 4″ (11″)				
Slate, gray 0 1 Jollytown	1.0	410.0		
Coal 0 6				
Limy shale, gray at top, red at bottom	25.0	435.0		
Massive sandstone, forming cliff, **Upper Marietta**	33.0	468.0	65′	
Sandy shale	6.0	474.0		
Coaly shale and slate, Washington "A"	1.0	475.0		
Shale	15.0	490.0		
Black slate (3″)	0.2	490.2		140.7′
Limy shale, variegated and red	10.0	500.2	35.2′	
Limestone, silicious and limy shale, Middle Washington	10.0	510.2		

	Thickness Feet	Total Feet		
Sandstone, massive, **Lower Marietta**	30.0	540.2		
Shale	2.0	542.2		
Dark shale (4″)	0.3	542.5	40.5′	
Buff limy shale	6.0	548.5		
Coal, slaty ..0 8″ / Coal, good ..1 7 — **Washington**	2.2	550.7		
Gray limy shale	15.0	565.7		
Sandstone and shale	42.0	607.7		
Slate with streaks of coal....0′ 2″ / Shale, gray ..1 0 / Coal, slaty .. 0 10 / Coal .....0 8 — **Waynesburg** / **"A" Coal**	2.7	610.4	59.7′	
Fire clay, thin sandstone and shale	10.0	620.4		119.3
Massive sandstone, forming cliff, **Waynesburg**	35.0	655.4	59.6′	
Shales, sandy	3.0	658.4		
Limestone, dark gray, flaggy, Elm Grove	2.0	660.4		
Concealed	9.6	670.0		

Waynesburg coal, place for but concealed

This is a very important section on account of the number of coal seams exposed in the Dunkard series and also for the fact that it establishes beyond doubt the identity of the Washington coal seam both in this section and at the mouth of Coal fork of Doolin run, 1 mile east of New Martinsville, from which latter point the Washington coal has been traced by the writer around the river hill to the place where this section was made. The Lower Marietta sandstone and the Middle Washington limestone are found at their proper intervals above this coal as will be noticed by the Rosbys Rock section on page 86 of this report. The northwestward thinning of the formations has reduced the Jollytown-Washington coal interval over 50 feet less than in the river hill section southwest of New Martinsville, (see page 101). The Elm Grove limestone also appears in the section. From the base of this limestone to the river level, 85 feet lower, everything was concealed, but the place for the base of the Dunkard series was estimated from the limestone.

A section measured by aneroid by the writer in the state

of Ohio, opposite New Martinsville, from the top of a hill down the hill road just south of the mouth of Texas run, gave the following exposures for the Dunkard series:

Section on West Side of Ohio River at New Martinsville.

	Thickness Feet	Total Feet		
Shale on top of hill	5.0	5.0		
Sandstone, **Fish Creek**	45.0	50.0		
Concealed	25.0	75.0		
Shale and sandstone	30.0	105.0		
Concealed	5.0	110.0	145′	
Reds	5.0	115.0		
Sandy shale	20.0	135.0		
Massive sandstone, **Jollytown**	10.0	145.0		
Shale, dark, Jollytown	0.3	145.3		
Massive sandstone with shale layers	29.7	175.0		
Shale, concealed and reds	20.0	195.0		
Sandstone, shale and sandstone	20.0	215.0		
Dark shale and fire clay	0.2	215.2		
Shale, gray	4.8	220.0		
Sandstone, flaggy	30.0	250.0		
Sandy and red shale	10.0	260.0	800.3′	
Sandstone, massive, friable at top	45.0	305.0		
Dark shale and fire clay	0.5	305.5		
Sandy shale	24.5	330.0		
Shale, gray	4.0	334.0		
Coal (4″) "rider" to Washington Coal	0.3	334.3		
Limestone, dark blue and hard	1.0	335.3		
Concealed	10.0	345.3		
Coal blossom, Washington	0.0	345.3		
Concealed	9.7	355.0		
Sandstone, with shale layers, **Mannington**	23.0	378.0	52.7′	
Fire clay, bluish	2.0	380.0		
Sandstone with shale layers	20.0	400.0		
Sandy shale	8.0	408.0		
Coal, slaty, Waynesburg "B"	2.0	410.0		136.7
Concealed	29.0	439.0	31′	
Coal, Waynesburg "A"	1.0	440.0		
Concealed	42.0	482.0	43′	

Waynesburg coal (639B—A. T.)

This Ohio section is given to show the position of both the Waynesburg "A" and Waynesburg "B" coals above the true Waynesburg coal. The Fish Creek or great cliff rock on the West Virginia side of the river 2 miles below New Martinsville is well developed here also, having a thickness of at least 45 feet. The base of the sandstone was concealed. The Jollytown-Washington coal interval is practically the same as on Doolin run.

Several sections will now be given to show the continuity and character of the Dunkard series in Tyler county.

A section measured by aneroid northeast from the top of a high knob 1 mile southwest of Paden City down hill road to the Ohio river in the northwest corner of Lincoln district, Tyler county gives the following exposures for the Dunkard series:

Paden City Section in Lincoln District (Tyler County).

	Thickness Feet	Total Feet	
Sandstone, shale and concealed capping knob	35.0	35.0	
Concealed, mostly shale	60.0	95.0	155′
Concealed, but mostly sandstone	30.0	125.0	
Sandstone and sandy shale	30.0	155.0	
Limestone boulders (6″), Nineveh (?)	0.5	155.5	
Concealed and reds	19.5	175.0	70′
Concealed	50.0	225.0	
Sandstone, friable	35.0	260.0	
Reds	4.0	264.0	
Shale, bright yellow (8″)	1.0	265.0	
Shale	5.0	270.0	
Sandstone, friable at top	10.0	280.0	130′
Concealed	25.0	305.0	
Reds	45.0	350.0	
Sandstone, friable and concealed	5.0	355.0	
Fire clay trace	0.0	355.0	
Deep dark reds	20.0	375.0	
Red shale with brecciated limestone fragments	20.0	395.0	55′
Sandstone, massive	5.0	400.0	
Red shale	5.0	405.0	
Sandstone and concealed	5.0	410.0	

	Thickness Feet	Total Feet		
Dark red shale with 5′ of limy sandstone	25.0	435.0		
Sandstone, limy and sandy shale	15.0	450.0	85′	
Red shale with thin sandstones	40.0	490.0		
Massive sandstone	5.0	495.0		
Coal blossom, (fragments of coal), Washington "A"	0.0	495.0		
Concealed	10.0	505.0		
Buff sandy shale	10.0	515.0		
Sandstone, massive (old quarry)	30.0	545.0	80′	
Reds	15.0	560.0		200′
Limy shale, yellow and sandstone	10.0	570.0		
Red shale,	5.0	575.0		
Limestone, nodular, **Middle Washington**	0.5	575.5		
Shale, limy	4.5	580.0		
Concealed	5.0	585.0	35′	
Sandstone, limy, yellow, with trace of fire clay on top, and shale	10.0	595.0		
Concealed, mostly sandstone	15.0	610.0		
Coal blossom 0′ 0″ / Concealed 0 5 / **Coal blossom** 0 0 } **Washington Coal.** (735 A.T.)	5.0	615.0		
Shale, limy	5.0	620.0	125′	
Massive sandstone, **Mannington**	30.0	650.0		
Sandy shale and sandstone	10.0	660.0		
Concealed (river gravel)	75.0	735.0		
Waynesburg coal, place for, not seen, 15′ above low water				

The important horizons in this section above the Washington coal appear to be concealed or absent. The Washington has an elevation here of about 735′ A. T. and is rising rapidly to the southwest up the "nose" of the Sistersville anticline. The 6″ of limestone near the top of the section may represent a limestone sometimes found 40 to 50 feet above the Nineveh coal, or it might be the top portion of the Nineveh limestone itself. A section of the Dunkard series at Sisters-

Plate VI.—View of Tyler County Topography, Looking Westward From Summit of Owlshead Knob, Same County.

ville will be found on page 120, illustrating the general geology.

A section measured by aneroid northeast down the hill road to Polard P. O. on Elk fork, 2½ miles S 60° E of Kidwell, gave the following succession for the Dunkard series in Ellsworth district, Tyler county:

Section at Polard P. O. on Elk Fork, Ellsworth District.

	Thickness Feet	Total Feet		
Concealed from top of knob..	120.0	120.0		
Massive sandstone	20.0	140.0		
Concealed and reds	59.0	199.0	200′	
Fire clay, white, Dunkard coal horizon (?)	1.0	200.0		
Dunkard reds	8.0	208.0		
Sandstone, limy and nodular ..	2.0	210.0		
Red shale	15.0	225.0		
Massive sandstone	10.0	235.0		
Sandy shale	10.0	245.0	50′	
Reds	5.0	250.0		
Fire clay, white (6″), Jollytown coal horizon (?)	0.0	250.0		
Gray shale	5.0	255.0		
Dark red shale	25.0	280.0		
Buff shale	15.0	295.0		
Massive sandstone	20.0	315.0	75′	
Red and sandy shale	10.0	325.0		
Coal (3″), Washington "A" (?)	0.0	325.0		
Shale, gray	10.0	335.0		
Concealed	5.0	340.0		
Concealed, (old terrace)	10.0	350.0		202.2′
Reds	10.0	360.0		
Sandstone and concealed	40.0	400.0		
Reds	15.0	415.0		
Flaggy sandstone and shale, ..	25.0	440.0		
Coaly shale (2″), "Washington Rider"	0.0	440.0	127.2′	
Shale and sandstone, massive.	7.0	447.0		
Concealed	3.0	450.0		
Coal, slaty ..0′ 2″ ⎫ **Washington**				
Slate, gray ..0 5 ⎬	2.2	452.2		
Coal, good ..1 8 ⎭ **Coal**				
Concealed to fork of road where U. S. 733 A.T. is on map	35.0	487.2	37.7′	
Concealed to Elk Fork creek..	2.7	490.0		

Only the Washington coal appears to hold its own in the Dunkard series in middle and eastern Tyler counties as will appear in this section. The interval up to the Washington "A" coal from the Washington seam has thickened up to 127 feet.

A section measured by aneroid northwest down hill road from the top of "Owlshead" knob, Tyler county, to Little Sancho creek, gave the following for the Dunkard series in Meade district:

Owlshead Knob Section, Meade District, Tyler Co.

	Thickness Feet	Total Feet		
Sandstone and concealed from top of knob	10.0	10.0	45′	
Massive sandstone, coarse and brown, **Gilmore**	35.0	45.0		
Concealed to bench	15.0	60.0		
Sandstone and concealed	35.0	95.0		
Massive sandstone	25.0	120.0		
Concealed	10.0	130.0	115′	
Sandstone, forming steep bluff, **Taylor**	30.0	160.0		230′
Concealed	60.0	220.0		
Massive sandstone, coarse and brown, forming large boulders, **Nineveh**	55.0	275.0	115′	
Concealed	5.0	280.0		
Red shale	5.0	285.0		
Massive sandstone forming large boulders	**Burton?** **Sandstone** 30.0	315.0	80′	
Concealed to bench	20.0	335.0		
Sandstone	15.0	350.0		
Concealed and reds	5.0	355.0		170′
Fire clay, (3″) white, Hostetter Coal horizon	0.0	355.0		
Shale, gray and limy top, dark red bottom	15.0	370.0	90′	
Concealed and reds	35.0	405.0		
Red and sandy shale	25.0	430.0		
Concealed	15.0	445.0		

	Thickness Feet	Total Feet		
Fire clay, Dunkard Coal horizon (?)	0.0	445.0		
Limy shale	5.0	450.0		
Concealed (old terrace deposits)	60.0	510.0	145′	
Massive sandstone, coarse, forming cliff, **Upper Marietta**	60.0	570.0		
Red shale	20.0	590.0		175.3′
Coal .... 0′ 2½″ **Washington "A"**.				
Slate, gray 0 0½ **Washington "A"**.	0.3	590.3		
Coal ..... 0 0¾ **Coal**			30.3′	
Concealed to Little Sancho Creek	30.0	620.3		

The Washington coal should come near 50 feet below the base of this section, since at Bert P. O. ¾ mile northeast, it has an elevation of 800′ A. T. and is rising slightly in the direction of Bert from Owlshead Knob. The several coal seams above the Washington "A" appear to be absent from the section or are only represented by fire clay horizons. The Upper Marietta sandstone forms quite a marked cliff in this region. The several limestones in the Dunkard series are either absent or concealed. The Gilmore, Taylor, Nineveh, Burton and Upper Marietta sandstones all appear to be present in their proper horizons in good thickness. The Nineveh and Fish Creek are hard and coarse and strew the hillside with large boulders.

A section measured by aneroid northwest down the hill road, ⅔ mile southwest of Falls Mills near where Middle Island creek finally passes out of Tyler into Pleasants county, in conjunction with the log of the Clark Smith No. 1 well (T 258) gives the following succession for the Dunkard series in the northwest corner of Meade district, Tyler county:

Section ⅔ Mile Southwest of Falls Mills, Meade District.

	Thickness Feet	Total Feet	
Concealed from top of hill ..	70.0	70.0	
Fire clay, (spring) concealed, Jollytown Coal (?)	0.0	70.0	70′

	Thickness Feet	Total Feet	
Concealed	45.0	115.0	
Shale, red and variegated	5.0	120.0	90′
Sandstone, with red shale layers, Upper Marietta	40.0	160.0	
Dark shale and fire clay (2″), Wshington "A" Coal	0.0	160.0	
Red shale	15.0	175.0	
Concealed	20.0	195.0	55′
Sandstone, greenish and friable, Lower Marietta	19.0	214.0	
Shale	1.0	215.0	
		(783′ B—A. T.)	
Dark, bituminous shale (2″) and fire clay, Washington Coal	0.0	215.0	
Limy shale, gray and variegated	25.0	240.0	
Sandstone, friable, Mannington	25.0	265.0	
Red shale	10.0	275.0	120′
Sandstone	10.0	285.0	
Red shale	5.0	290.0	
Concealed to top Clark Smith No. 1 well (663′ L—A.T.)	45.0	335.0	

Waynesburg coal not seen, concealed

In the Clark Smith No. 1 well, the top of the Pittsburg coal was found at a depth of 300 feet, 1275 feet above the top of the Big Injun Sand, and this establishes beyond doubt the approximate base of the Dunkard series at 335 feet and the horizon of the Washington coal at 215 feet from top of section. The latter coal appears to have thinned out and become of no economic importance in the area surrounding Falls Mills, Bowles Mills and Shiloh as is revealed by still another section measured by aneroid down the steep hill on the South side of Middle Island creek, ½ mile N 75° W of Shiloh where the following exposures were found for the Dunkard series in Union district.

Shiloh Section, Union District, Tyler County.

	Thickness Feet	Total Feet	
Unrecorded from top of hill..	115.0	115.0	
Massive sandstone	15.0	130.0	
Concealed and shale	10.0	140.0	
Massive sandstone, **Upper Marietta**	10.0	150.0	160′
Concealed with trace of **Coal blossom (Washington "A")** in debris	10.0	160.0	
Red and buff shale	10.0	170.0	
Massive sandstone, friable at top, Lower Marietta	68.0	238.0	
Shale	2.0	240.0	80.4′
Coal (4″) Washington (740′ B—A.T.)	0.4	240.4	
Shale, sandy, red and variegated	20.0	260.4	
Sandstone	5.0	265.4	
Red and sandy shale	30.0	295.4	
Concealed	9.0	304.4	115′
Black slate with streaks of coal, Waynesburg "A"	1.0	305.4	
Concealed to Middle Island creek	50.0	355.4	

This section is almost down to the base of the Dunkard series and the Waynesburg coal horizon must not be over 5 to 10 feet below the level of Middle Island creek at this point. The Middle Washington limestone has disappeared entirely. The Washington coal seam is only 4 inches thick and it has fallen from its elevation (783′ B—A. T.) in the Falls Mills section to 740′ B—A. T. This is in harmony with the dip of the Pittsburg coal to the northwest from Falls Mills, and this section is near the low point of the Shiloh syncline. The Lower Marietta sandstone has become very massive.

All the foregoing sections of the Dunkard series are so scattered as to give a fair idea of the thickness and proper horizons of the different formations of the Dunkard series in the Marshall-Wetzel-Tyler area. The detailed dscription of the various formations of the series will now be taken up.

DESCRIPTION OF THE DUNKARD FORMATIONS.

The different beds of the Dunkard series in descending order have been given the following names:

Proctor Sandstones.
Windy Gap Limestone.
Windy Gap Coal.
Gilmore Sandstone.
Gilmore Coal.
Gilmore Limestone.
Taylor Sandstone.
Nineveh Sandstone.
Nineveh Coal.
Nineveh Limestone.
Burton Sandstone.
Hostetter Coal.
Fish Creek Sandstone.
Fish Creek Coal.
Rush Run Sandstone.
Dunkard Coal.
Jollytown Sandstone.
Jollytown Coal.
Upper Washington Limestone.
Hundred Sandstone.
Hundred Coal.
Upper Marietta Sandstone.
Washington "A" Coal.
Middle Washington Limestone.
Lower Marietta Sandstone.
Lower Washington Limestone.
Washington Coal.
Washington Sandstone.
Little Washington Coal.
Mannington Sandstone.
Waynesburg "B" Coal.
Waynesburg "A" Coal.
Waynesburg Sandstone.
Elm Grove Limestone.
Cassville Plant Shale.

The Proctor Sandstones.

The summit of the Dunkard series appears to be capped by a series of great massive sandstones. These seem to form two or three ledges, separated by red and sandy shales, ranging in thickness from 30 to 50 feet. The writer has named these the **Proctor** sandstones from the magisterial district of that name in Wetzel county, in the eastern portion of which they cap a very high knob ¾ mile southwest from West post office, where their total thickness with included shales is near 150 feet (see section at West P. O., page 154). This series of sandstones crown the summits of several of the high knobs along the deep Nineveh syncline in Wetzel as well as several of the high knobs along the dividing ridge forming the boundary line between the latter county and Monongalia, Marion and Harrison counties, W. Va. The highest knob in the Marshall-Wetzel-Tyler area (Honsocker) in the northeast corner of Wetzel county is capped by the Proctor sandstones. The top of the Pittsburg coal seam is 1325 feet beneath the summit of this knob. The high knob ¾ mile southwest of Uniontown, Wetzel county is also crowned by this series of sandstones. The 70 feet of measures at the top of the Doolin run section appears to represent the Proctor sandstones.

The Windy Gap Limestone.

This formation comes next in descending order below the Proctor sandstones and is the highest persistent limestone of the Dunkard series. It was named by Dr. I. C. White[11] the Windy Gap limestone from its occurrence near Windy Gap, a "divide," separating the Laurel branch of Fish creek from Wheeling creek, in Springhill township, Greene county, Pa. Concerning this stratum Dr. White has the following to say on page 106 of Vol. II of the W. Va. Geological Survey reports:

"Like all other limestones of this Dunkard series, it is of fresh water origin, and contains only minute fossils, apparent-

11 Bull. No. 65, p. 30, U. S. Geol. Survey.

ly only bivalve crustacea, but as these forms have never been studied, nothing definite is known of their specific or even generic type. The rock weathers to a light gray on the surface, but a fresh fracture is dark bluish in color, and the several layers have a thickness aggregating 8 to 10 feet."

This limestone occurs near the summits of the high hills near Boardtree, and Bellton, Marshall county; Silver Hill, West, Wileyville and Halls Mills, Wetzel county, along the deep Nineveh syncline. It is also found near the summits of the high knobs along the eastern boundary line of Wetzel. Along the Nineveh trough it comes about 980 feet above the base of the Dunkard series, or 1290 to 1300 feet above the top of the Pitsburg coal as shown by the West P. O. section on page 154. Dr. White's Boardtree section placed this limestone 1057 feet above the base of the Dunkard series which is probably excessive, due to barometic measurement without accurate spirit level checks on the summit of the hills, since the revised Bellton section on page 142 places this stratum only about 890 feet above the base of the Dunkard or 1200 feet above the top of the Pittsburg coal. The northwestward thinning of the formations would probably account for the 90 feet less interval at Bellton above the base of the Dunkard series than at West P. O. At its type locality in Greene Co., Pa., the base of this limestone comes 1290 to 1300 feet above the top of the Pittsburg coal or the same interval as at West P. O.

The Windy Gap limestone is too high in the series to catch any of the high hills of Tyler county with the possible exception of the highest knob in the county, located 2 miles N 48° E of the fork of the road at Alvy (Stringtown) where the Pittsburg coal has dipped down into the Burchfield syncline to approximately 200′ A. T. The summit of the knob is 1500′ A. T., or 1300 feet above the latter coal seam. A section of the top portion of this knob made by the writer gave the following:

			Thickness Feet	Total Feet
1	Sandstone, friable, capping knob..	..... Proctor?	30.0	30.0
2	Red shale and concealed	sand-stones	40.0	70.0
3	Sandstone, massive	.....	30.0	100.0
4	Concealed		40.0	140.0
5	**Fire clay, (12") Windy Gap coal horizon (?)**		1.0	141.0

The 12" of fire clay may represent the horizon of the Windy Gap coal and if so the limestone would be in the 40 feet of concealed interval next above, and its interval above the top of the Pittsburg coal would have thinned down to near 1200', and the 100 feet of sandstones and concealed interval at the top would represent the Proctor sandstones.

The 300 to 350 feet of measures between this limestone and the next limestone, the Nineveh, below often carry 2 or 3 thin limestones in Wetzel and Marshall counties, the upper coming about 100 feet below the Windy Gap and the lower 75 to 100 feet above the Nineveh limestone. None of these with one exception, the Gilmore, however, appears to be persistent enough to warrant naming. The upper one is often taken for the Windy Gap.

These limestones in conjunction with the Windy Gap, coming so high up on the ridge lands of Marshall and Wetzel county contribute much to the fertility of the upland soils of the Permian or Dunkard series.

The Windy Gap Coal.

The highest known coal or bituminous formation of the Dunkard series has been named the Windy Gap coal by Dr. I. C. White from the type locality of the Windy Gap limestone in Green Co., Pa., where it occurs at 25 to 30 feet below the latter. Concerning this Dr. White has the following to say in Vol. II, page 107, W. Va. Geological Survey reports:

"At 25 to 30 feet below the Windy Gap limestone, there occurs an impure **coal** or **coaly shale** which has been observed at a few localities in West Virginia. It is the highest known

bed of anything approaching coal in composition, in the Dunkard series. Where seen in the tops of the knobs near Bellton, Marshall county, or near St. Cloud, Monongalia county, it appears to be little better than a highly bituminous shale, although near Windy Gap, Greene county, Pa., some actual coal occurs at this horizon, although as far as known it has never been dug for burning, and is of interest only as being the highest known bituminous stratum yet found in the Appalachian basin." St. Cloud, referred to above is just across the northeast boundary line of Wetzel county, and the bituminous shale mentioned near this place as representing the Windy Gap coal is a carbonaceous shale associated with the limestone that comes near 75 to 100 feet below the Windy Gap coal, since at this point this shale is only approximately 1215 feet above the top of the Pittsburg coal, or 240 feet above the Nineveh limestone, and is possibly the same carbonaceous shale found by the writer just below the base of the Gilmore sandstone near its type locality on the extreme head of Hamilton run of Fish creek, Gilmore township, Greene Co., Pa. On the south side of the low gap in the edge of public road, 1 mile southwest of West P. O., Proctor district, Wetzel county, the writer found 8 inches of actual coal with slaty layers at the Windy Gap horizon below 10 inches of hard gray limestone. This coal should be present in the summits of several of the high knobs of southeastern Marshall and eastern Wetzel counties, but the thick covering of soil effectually conceals its horizon. It was not found in Tyler county, but is probably present in the summits of the high knobs along the Wetzel county line in the extreme eastern part of Tyler. It never attains a thickness sufficient to have any economic value anywhere in the Marshall-Wetzel-Tyler area, and is of interest only in being the highest coal, geologically considered, in the Appalachian basin.

The next 50 to 75 feet of measures below the Windy Gap coal is made up of red sandy shales, sandstones and sometimes a limestone, none of which appears sufficiently persistent to warrant a name. The sandstones often get quite massive and are sometimes taken for the Gilmore sandstone below.

In the Burton section the high knob from which the measurements were made is crowned by one of the massive sandstones of this interval which has become quite massive. It appears to be this same rock that forms a cliff 4-10 mile N 20° W of St. Cloud near the head of Cappo run of Church fork in the northeast corner of Wetzel county where it is quarried for building purposes. Its base comes 1260 feet above the top of the Pittsburg coal as against 1190 feet for the interval of the base of the Gilmore sandstone above the Pittsburg coal at its type locality 2½ miles northeast.

The Gilmore Sandstone.

The next important stratum in descending order in the Dunkard series is the Gilmore sandstone, named by Prof. J. J. Stevenson from its occurrence in the township of that name in southwestern Greene county, Pennsylvania, where it is conspicuous in long lines of cliffs near the summits of the hills. It is a massive bed of coarse, yellowish brown sandstone, whose cliffs are always traversed by fissures that furnish a retreat for foxes when chased by hounds and for that reason it is sometimes called the "Fox Rocks." It is an excellent stone for building purposes and has been quarried quite a good deal in the edge of Greene Co., Pa., just across the line from Wetzel county W. Va. This stratum has played no small part in preserving the top portion of the Dunkard series from erosion in southeastern Marshall and eastern Wetzel and Tyler counties, and holding up the "ridge lands" into broad fields favorably adapted for agriculture. At its type locality on the head of Taylor run, Gilmore township, Greene county, Pa., the base of this rock comes 215 feet above the Nineveh coal and 1190 feet above the Pittsburg coal.

Often it is not exposed as a cliff but simply makes a well defined bench in the topography. In Marshall county in the section measured 1 mile southwest of Bellton (Denver Station) this sandstone is a great ledge, 50 feet thick with its base 1145 feet above the top of the Pittsburg coal. At Rocklick, Cameron District, it appears to be this rock that caps the high

knob, ½ mile to the south, from the top of which the Rocklick section was made. The summit of the knob is about 1080 feet above the Pittsburg coal. In the Glen Easton section the 24 feet of massive sandstone and shale at the top appears to represent the horizon of the Gilmore sandstone and is near 1080 feet above the Pittsburg coal. In the Hog run section the 30 feet of massive sandstone, 160 feet above the Nineveh limestone, appears to be this same stratum.

In Wetzel county this rock was noted in several of the sections measured. In the Burton section it is close 20 feet in thickness and 208 feet above the Nineveh coal, and at Littleton its base comes 1160 feet above the top of the Pittsburg coal. At Wileyville it is 20 feet in thickness and its base 210 feet above the Nineveh coal. It appears to be the Gilmore sandstone that crowns the summit of "Owlshead" knob at Jacksonburg, Wetzel county, where it is 50 feet in thickness and its base 1197 feet above the Pittsburg coal. In the West P. O. section it is close 25 feet in thickness and 197 feet above the Nineveh coal. In the Smithfield region it caps a high knob south of the town, 1,200 feet above the Pittsburg coal. At this point it is coarse and massive, but its thickness was not exposed. It appears to be this same rock that holds up the summit of the high knob in the edge of Tyler county, 1 mile southwest of Paden City. It appears to be this same great sandstone that caps the summit of "Owlshead" Knob, Tyler county, where it is 35 to 45 feet thick and its base comes over 1000 feet above the Pittsburg coal. It was not noted at any other point in Tyler, but no doubt crowns the summits of several of the knobs in the extreme eastern part of the county.

Gilmore Coal.

On the head of Hamilton run in the extreme eastern portion of Gilmore township, Greene county, Pa., and 1 mile north of the West Virginia-Pennsylvania State line, the writer found 3 inches of **coaly shale** at the base of the Gilmore sandstone, and for this reason has termed it the **Gilmore**

Coal. On the head of Wolf run of Fish creek, 2 miles north of Littleton 6 inches of slaty coal occurs at this horizon at 1433′ A. T., coming directly over 6 inches of hard gray limestone. Its interval above the top of the Pittsburg coal seam at this point is close 1190 feet, or nearly 100 feet below the horizon of the Windy Gap coal. In the southern part of Center district, Wetzel county, ¾ mile southwest of Uniontown, 8 inches of coaly shale occurs at this horizon directly over 6 inches of dark gray limestone. Its interval above the Pittsburg coal at this point is the same as near Littleton. The dark shale over 1 foot of hard gray limestone in the Rosbys Rock section appears to represent this horizon, coming as it does close 200 feet above the top of the Nineveh limestone.

The Gilmore Limestone.

The 6 inches of limestone coming directly under the Gilmore coal in the vicinity of Littleton and Uniontown, Wetzel county, have been termed the **Gilmore Limestone** by the writer. In the Rosbys Rock region it is hard and gray and 1 foot in thickness and comes near 175 feet above the horizon of the Nineveh coal. It appears to be this same stratum 5 feet in thickness at base of a massive sandstone (Gilmore?) in the Hog run section and if so, the Gilmore coal has been cut away by the upper rock. The next 100 to 150 feet of measures below the Gilmore limestone is composed of red sandy beds, sandstones and sometimes a limestone. None of these appears to be persistent or easily identified and for that reason have not been named.

The Taylor Sandstone.

Another very persistent sandstone comes into the measures about 150 feet below the base of the Gilmore sandstone and has been named by the writer the **Taylor Sandstone** from its occurrence on a run of that name in the southwest corner of Gilmore township, Greene county, Pa., at which point it is 20 to 25 feet in thickness and its base comes close 70 feet

above the Nineveh coal. This sandstone forms conspicuous bluffs along the steep hillsides of Wetzel county, sometimes making a vertical cliff 25 to 30 feet in heighth. In the Burton hill section this sandstone is 40 feet in thickness with its base 85 feet above the Nineveh coal. At this point 5 feet of dark gray limy shales with limestone nuggets occurs 5 feet below the base of this sandstone which possibly corresponds to a limestone frequently found 50 to 75 feet above the Nineveh coal. At Wileyville the Taylor sandstone is 45 feet thick and comes 100 feet above the Nineveh coal. At Jacksonburg, Wetzel county, this sandstone appears to have thickened up to a great mass on the slope of "Owlshead" Knob, having a total section of 165 feet with 15 feet of concealed interval 50 feet above the bottom. This is by far the greatest thickness found for any sandstone in the Dunkard series. In the original Bellton section of Dr. I. C. White this same stratum is 40 feet thick and its base comes 73 feet above the Nineveh coal. Near West P. O., Proctor district, Wetzel county, it is 20 feet in thickness, very coarse and massive, and comes 62 feet above the Nineveh coal. This rock was identified at only one point in Tyler county; viz., on the west side of "Owlshead" Knob, where it is 30 feet thick and forms a very steep bluff along the hillside.

The Nineveh Sandstone.

The next great sandstone below the Taylor is the Nineveh which has been designated from its good development a few feet above the coal of that name near the village of Nineveh, Greene county, Pa. The stone is a yellowish gray in color and, like the Taylor and Gilmore sandstones above, gives rise to cliffs and steep bluffs in Marshall, Wetzel and eastern Tyler counties. It has frequently been quarried for building purposes in Wetzel but is not very satisfactory for use in exposed structures, since the sand grains are so loosely cemented together that it crumbles on exposure to the weather. It ranges in thickness from 10 to 40 feet and its

base generally comes 5 to 15 feet above the Nineveh coal. The Taylor sandstone above is frequently taken for the Nineveh. In the Bellton section measured by the writer 1 mile southwest of the town, it had a total thickness of 75 feet the greatest found in the Marshall-Wetzel-Tyler area. At this point its base was only 5 feet above the Nineveh coal. At West P. O., Wetzel county it is 20 feet thick and somewhat flaggy. In the region of Pine Grove, Jacksonburg, Smithfield and Piney, Wetzel county, it is very massive and forms cliffs and steep bluffs. It appears to be this sandstone near the top of the Middlebourne section where it crowns a high knob. In the "Owlshead" knob section, Meade district, Tyler county, a great massive, coarse, brown sandstone appears at 210 feet from the top which is probably the Nineveh. It strews the west hillside of the knob with large boulders.

The Nineveh Coal.

The Nineveh coal, coming at the base of the sandstone of that name, was so called by Dr. John J. Stevenson from the village of Nineveh, Greene county, Pa. It is seldom over 1 foot in thickness and has frequently been mined by the farmers of Wetzel county for domestic use, and furnishes a fair grade of fuel, although quite high in ash. Accurate levels in the Burton section show this coal to be 990 feet above the top of the Pittsburg coal; the same interval at Littleton to be 1005 feet, and at the Kinsey Renner No. 1 well (W 11) in the extreme southeast corner of Springhill township, Greene county, Pa., ¾ mile east of the Wetzel-Monongalia county corner on the State line, to be 965 to 975 feet. This interval decreases north and west toward the Ohio river from this region and at Majorsville is 745; Rosbys Rock, 750; and at New Martinsville, 835 feet. The Nineveh coal was found to be quite generally present in middle and eastern Marshall county. In Webster district, 2 miles east of Pleasant Valley 5 inches of slaty coal occurs at this horizon 5 feet above 7 feet of limestone. The Nineveh-Pittsburg coal interval is ap-

proximately 830 feet at this point. In Liberty district, the same county, ½ mile northwest of Woodruff, the Nineveh coal is 13 inches thick and quite pure. At Boardtree tunnel it is about 1130′ A. T. and near 970 feet above the Pittsburg coal, the latter point being in the extreme southeast corner of Marshall county. It is also found on the head of Big run, 2 miles south of Cameron where it is 10 inches thick and about 1235′ A. T. and comes 25 feet above the Nineveh limestone. Near the western edge of Liberty district on the hill road leading to the north, 1 mile up from mouth of Maggoty run, only 2 inches of bituminous shale is found at this horizon, coming 22 feet above 10 feet of dark gray limestone, while 7 inches of coal is found at the same horizon ½ mile southwest of this point. In the original Bellton section of Dr. I. C. White the Nineveh coal was given a thickness of 1 foot, but in the section measured by the writer on page 141, only 3 inches of coaly shale occurs. Along the Ohio river front of Marshall, the section given on page 95, 2 miles southeast of Clarington station shows 1 foot of dark bituminous shale at the horizon of the Nineveh coal, and its interval above the Pittsburg bed at this point approximates 800 feet.

The Nineveh coal is found quite generally present either as coal or bituminous shale over most of the area of Wetzel county. In Church district near the head of Church fork, 2½ miles east of Hundred, it was once mined on what is now the Lizzie Lemmon farm for domestic fuel. It was quite slaty and very high in ash. At this point it is 1000 feet above the Pittsburg coal as shown by the record of the Winona E. Shough No. 1 well (W 2) a few hundred yards west. Near the head of Cappo run of Church fork, ½ mile northwest of the summit of "Honsocker" Knob, this coal crops in the edge of the public road at approximately 1210′ A. T. and is 10 inches thick. In the Burton hill section, this coal comes 990 feet above the top of the Pittsburg coal and is almost 1 foot thick. At the west end of Glovers Gap tunnel it comes 20 to 25 feet above railroad grade, is only 4 inches thick and quite slaty. Its tidal elevation at this point is about 1180 feet.

At Littleton, Clay district, Wetzel county, only a bituminous shale appears at this horizon, near 1275′ A. T., but in the northeast corner of Center district, Wetzel, this coal has dipped down to 1165′ A. T. as exposed in the hill road leading southwest from Wade P. O. at the mouth of Knob fork. At this point the coal seam has a section of 5½ inches, with 2 inches light gray shale containing fossil plants, 2½ inches from the bottom. The coal dips westward on the slope of the Littleton anticline and ½ mile southwest of Endicott on Miller run is down to 1120′ A. T. At the extreme northwest corner of Center district near Wileyville the Nineveh coal reaches its lowest elevation (1010′ A. T.) anywhere in the Marshall-Wetzel-Tyler area. At this point the coal is only 6 inches thick, and the Nineveh-Pittsburg coal interval is about 960 feet. East from Wileyville the rocks rise and on Honey run, 1 mile up from its mouth, the Nineveh coal is 1050′ A. T., 7 inches thick and quite pure. At West P. O., in Proctor district, 3⅓ miles due north of Wileyville, the Nineveh coal is 1090′ A. T., is 6 inches thick and quite pure. In the southwestern part of Proctor district near head of Mud run one mile and a half south of Andy, the Nineveh coal is 1155′ A. T. and its horizon is represented by 4 to 6 inches of slaty coal coming 3 feet above a yellowish limestone. Its interval above the Pittsburg coal at this point as revealed by the Anna Brachbuhlar No. 1 well (W 285) is near 900 feet. In Magnolia district, Wetzel, the Nineveh coal is represented in the Doolin run section, page 99, by 3 to 4 inches of dark slate coming directly over 5 feet of limestone, and 837 feet above the Pittsburg coal. This shows a convergence of the measures between these 2 coals from Burton at the east edge of Wetzel to New Martinsville at the west edge, of over 150 feet. In Grant district the Nineveh coal crops in the public road leading up hill northwest from Willey fork to Sincerity P. O. and is represented by only two inches of slaty coal, coming about 1010 feet above the Pittsburg coal. The Nineveh coal was not observed at any other point in Grant district, and its horizon was not noted in the sections made at

Pine Grove, Jacksonburg and Smithfield, published on preceeding pages of this report. This coal was not observed in Tyler county and appears to have thinned away before reaching there.

A sample of the Nineveh coal was collected for analysis by the writer from its exposure along the hill road, ½ mile west of St. Cloud, Wetzel county on the John Hagan Six farm. The Assistant Chemist of the Survey J. H. Krak reports as follows for this sample:

Promixate Analysis.	Per cent.	Ultimate Analysis.	Per cent.
Moisture	15.14	Carbon	35.75
Volatile matter	22.50	Hydrogen	5.05
Fixed carbon	32.63	Oxygen	27.34
Ash	29.73	Nitrogen	0.66
		Sulphur	1.47
		Ash	29.73
Total	100.00	Total	100.00

Sulphur 1.47
Phosphorus 0.04

Calorific value:
Calorimeter B. T. U.....
Calculated B. T. U. ..... 6,276.

The Nineveh Limestone.

The next important stratum in the Dunkard series below the Nineveh coal is the Nineveh limestone, and was so named by Prof. J. J. Stevenson from the village of Nineveh, Greene county, Pa. In the area under discussion this limestone ranges from a few inches to 25 feet below the Nineveh coal. This limestone usually occurs in several layers, separated by marly or sometimes bituminous shales and even coal as shown in the Bellton section measured by the writer on page 141 of this report, the whole having a thickness ranging from 5 to 15 feet. Some of the layers of this limestone are quite pure and others rather silicious. In the section of the Dunkard series west of Majorsville, this stratum is shown to be 10 feet thick. About 2 miles east of Pleasant Valley on

the ridge this limestone comes 5 feet below the Nineveh coal and is 7 feet thick. The upper 2 feet is yellowish in color, brecciated and friable, but the bottom portion gray, hard and slightly silicious. The outcrop of this limestone is well shown at both portals of Boardtree tunnel on the Marshall-Wetzel county line where it is over 15 feet in thickness. Its outcrop is also finely exposed in a ravine just east of the public road one mile and a quarter northeast of Bannen P. O., Liberty district, Marshall, where it has the following section:

	Ft.	In.		
Lmestone, dark, silicious....	0	6		
Black slate	5	0	16′	0″
Coal, slaty	0	6		
Limestone, gray and hard....	10	0		
Coal, good	0	8		
Concealed	26	0	27′	4″
Coal	0	8		

The Nineveh coal proper was found 25 feet higher. With one exception this was the only point where the writer found actual coal separating the different layers of this formation The two coal seams, each 8 inches thick are also an unusual feature directly under the Nineveh limestone and were not observed at any other point in the 3 counties. The lower 8″ of coal may represent the Hostetter bed since it comes 70 feet below the Nineveh coal almost the same as the latter's interval at its type locality north of Burton, Wetzel county, W. Va. Its outcrop is also exposed near the head of Big run, 2 miles south of Cameron, W. Va. It is also well exposed on the north hillside near road 1 mile up from mouth of Maggoty run where it is over 10′ thick, blue and hard at top, but gray at bottom, with limy shale separating the harder layers. In Meade district, Marshall, its outcrop occurs near the head of Middle Bowman run where 2 feet is visible directly underlying 6 inches of slaty coal. It was also observed in the Rosbys Rock, Franklin and Clarington sections in Marshall county. At the latter point it is 10 feet thick, silicious and comes 30 feet below the Nineveh coal.

In Wetzel county this limestone is quite persistent and has been observed at a number of points in northern and western Wetzel, but is absent or concealed in the southeastern part of the county. In Church district its outcrop can be observed at a number of points. Near the head of Church fork of Fish Creek, 1 mile southwest of St. Cloud P. O. it is exposed on the west side of the road a short distance below the residence of Geo. Renner, where it is 6 to 8 feet thick, and quite silicious. It is also exposed in the road leading southwest over the hill to Burton, and in the Burton section has a thickness of 2 feet. Here it is quite silicious and comes only 3.4 feet below the Nineveh coal. In Clay district, at Littleton, its outcrop is well exposed in the road leading southwest up the hill from Martin tunnel at the upper end of the town. At this point its top is 1265′ A. T. and is 7 feet thick, gray and hard at top and bottom, with 2½ feet of limy shale 4 feet from top. It is also well exposed in Center district, Wetzel, on both hillsides along the road leading across the hill from Wade P. O. at mouth of Knob fork to Rockport at mouth of Carney fork of Rocky run. On the Knob fork side of the hill 10 feet of limestone is exposed where it has weathered to a yellowish gray color, but has a bluish color on fresh fracture. On the side next to Rockport it has the following section descending:

Limestone, gray and hard	0′	10″
Shale, limy	1′	00″
Coal, slaty	1′	00″
Limestone, gray and hard at top, friable and silicious at bottom	5′	00″
Total	7′	10″

The 12 inches of coal in the section as well as one given southwest of Bellton shows the bituminous nature of the dark separating shales of this formation. The horizon of the Nineveh coal proper is represented by dark bituminous shale immediately over the upper limestone. This limestone is also

well exposed along Carney fork and Miller run, both being tributaries of Rocky run. Near the head of the latter stream at Dean P. O. this limestone is exposed along the public road. At Wileyville on the south side of Little Fishing it crops 200 feet above the stream directly under the Nineveh coal. Only 10" of dark gray limestone was visible at this point. Like the Nineveh coal it was not recognized in Grant district, but may have been concealed. In the eastern part of Proctor district, on the Middle fork of Lynn Camp run, 100 yards below West P. O. the Nineveh limestone is well exposed just before it dips below drainage where it is 8½ feet thick, gray, hard and silicious. The Nineveh coal, 6" thick, is exposed 4 feet above. The limestone is also well exposed along the road leading from Peabody eastward to Whetstone creek and north to St. Joseph, where it occurs in layers, the whole having a section of 10 to 15 feet. Along the Ohio river front of Wetzel county this limestone comes approximately 400 feet above the Washington coal. In the Proctor creek section this stratum is blue and hard and 3 feet in thickness, and comes 419 feet above the Washington coal. In the Doolin run section east of New Martinsville its top comes 400 feet above the Washington coal. At this point it is nodular, with a reddish cast at bottom, 5 feet in thickness, and immediately underlies the Nineveh coal. In the hand-level section down the river hill 3 miles southwest of New Martinsville, the Nineveh limestone comes 392 feet above the Washington coal and immediately over red beds. Only 2 feet of the bottom portion could be seen. In the most eastern point of Magnolia district, ½ mile northwest of Maud P. O., a limestone crops along the road 12 feet below a black, bituminous shale, 6" thick, containing fossil plant stems. This appears to represent the Nineveh limestone. Only 1 foot was visible, the intervals both above and below being concealed.

The Nineveh limestone comes too high in the measures to leave much of an outcrop in western Tyler. Its horizon was not recognized at any point in the county. If present near the summits of the high hills of eastern Tyler its horizon was effectually concealed at the many points visited by the writer.

Along the Ohio river front of this county the Sistersville anticline has so elevated the measures that the Nineveh limestone horizon misses the tops of the highest hills with the exception of the high knob, 1 mile south of Paden City.

This Nineveh limestone plays a very important part in helping to enrich the soil of Marshall and Wetzel counties, since its outcrop over most of their areas is high above drainage.

The Burton Sandstone.

At 25 to 30 feet below the Nineveh limestone near Burton, Wetzel county, a great sandstone comes into the series immediately over the Hostetter coal. The writer has termed this the **Burton sandstone** in the section given for this place. Its outcrop is well exposed near the foot of the hill along the public road leading north from Burton to Church fork where it is 35 to 40 feet thick and quite massive. It is also well exposed along the road on the north side of the same hill. On fresh fracture it is light gray in color. It forms the steep bluff just east of the residence of Winona Shough, one mile and a half northeast of Burton on Church fork. It is quite massive at Cottontown, ¾ mile southeast of Burton. One-third mile north of Glovers Gap tunnel it forms a cliff near the residence of Thomas Pogue just above the level of the creek. It is also the great cliff rock along Rush run, a stream putting into Fish creek 1 mile above Hundred. In Clay district near Littleton it forms conspicuous bluffs. In the section made at Wileyville this sandstone comes 35 feet below the Nineveh limestone and is 20 feet thick. It is no doubt often taken for the Nineveh sandstone a short distance above. It appears to lose its massive nature in Marshall county and its horizon is generally represented by sandy beds. It was not definitely recognized in Tyler county.

The Hostetter Coal.

Immediately underlying the Burton sandstone at Burton, Wetzel county, is found the Hostetter coal seam, so named by Dr. I. C. White in Bulletin 65 of the U. S. Geological Survey

on page 33 where he has the following to say concerning this coal:

"Occasionally a bed of coal occurs at 75 to 100 feet below the Nineveh limestone. It has been stripped out of the run on the old Hostetter farm near Burton, Wetzel county, W. Va., where it is 12 to 15 inches thick and rather pure."

On this old Hostetter farm (sometimes spelled Hostutler) this coal crops just back of the present residence of Philip Shough at an elevation of 1144' A. T., and is 6 to 8 inches thick, coming 917 feet above the top of the Pittsburg coal as shown by the log of the Winona E. Shough No. 1 well (W 2) near by. It has also been mined by stripping on the Santee farm, ½ mile south of the Shough residence, just above the home of Hon. J. W. Santee where it is 12 to 15 inches thick. One-fourth mile north of Burton its crop shows at the side of the public road just above the residence of Oliver Bartrug where it has a thickness of 12 inches, and comes at the base of the great Burton sandstone. Its interval above the Pittsburg coal here is 912 feet. A sample for analysis was collected by the writer in the bed of the run at this point on the Moses Bartrug farm on which J. H. Krak, Assistant Chemist of the Survey reports as follows:

Proximate Analysis	Per cent.	**Ultimate Value.**	Per cent.
Moisture	1.97	Carbon	67.57
Volatile Matter	36.39	Hydrogen	6.33
Fixed Carbon	48.31	Oxygen	8.07
Ash	13.33	Nitrogen	1.18
		Sulphur	3.52
		Ash	13.33
Total	100.00	Total	100.00

Phosphorus 0.042
Sulphur 3.52

Calorific Value:

Calorimeter, B. T. U. .....
Calculated B. T. U. 13,270

Mr. Henry Himelrick has also mined this coal, just above, for domestic use. Old abandoned openings in this seam are

found around the hill just north of Burton. It crops in the road one-tenth mile southeast of Cottontown at the base of a great sandstone at an elevation of 1130′ A. T. where it is 12 to 18 inches thick. It is dipping here to the southeast and at 8-10 mile southeast of Cottontown is down to about 1110′ A. T. where the following section was exposed:

	Ft.
Sandstone, massive, **Burton**	30
Sandy shale	2
Concealed	4
Coal, Hostetter	1
Concealed to creek	4

At this point the coal was almost flush with the top of the L. E. Pogue No. 1 gas well (W. 28), which shows this coal to be here 939 feet above the top of the Pittsburg seam, or a slight increase over its interval on Church fork. Its crop is exposed in the edge of the road a short distance below the Wm. Renner No. 1 gas well (W 10) at an elevation of 1160′ A. T., where it is 12 inches thick and quite pure, coming 910 feet above the top of the Pittsburg coal as shown by the log of the Renner well. This coal has been mined at several points near the head of Rush run, about 2 miles south of Burton where it comes immediately below the great cliff rock (Burton sandstone) along this stream. This coal has been mined for domestic fuel on the land of Jesse Stewart near the head of this same run at an elvation of about 1205′ A. T. where the following section was made by the writer:

	Ft.	In.
Massive sandstone, **Burton**, visible	20	0
Shale	3	0
Coal, Hostetter 12″ to	1	11

This coal does not appear to carry any characteristic partings like the Fish Creek and Dunkard coals below, but varies in the same locality quite a good deal in thickness. Its crop is exposed in the road up Burner run, ¾ mile south of Hundred, Wetzel county, as well as near the forks of the road at the head of left fork of Ash camp run, one mile and a half S. 10°

W. of Hundred. At both places it is about 1180′ A. T., 10 inches thick and quite pure. At the latter point it comes immediately under the massive Burton sandstone, the latter having a thickness of 25 feet. It seems to thin out and disappear southwest from Church and Clay districts in Wetzel. On Bear run of Knob fork, one mile and a half southeast of Endicott, only 6 inches of fire clay is found at its horizon where it comes 900 feet above the Pittsburg coal and 75 feet below the Nineveh coal, 8″ thick, exposed along the same road.

In Marshall county the **Hostetter coal** was recognized at several points. In the section measured by the writer southwest of Bellton, page 141, the 8 inches of coal, 70 feet below the Nineveh bed would appear to represent this horizon. It appears to thin out and disappear westward toward Tyler county for this bed was not noted in the latter county.

The Fish Creek Sandstone.

At 40 to 50 feet below the horizon of the Hostetter coal in the vicinity of Littleton comes a very massive sandstone that has been named the **Fish Creek sandstone** by Prof. J. J. Stevenson from its outcrop on the stream of that name in a great cliff near Deep Valley, Springhill township, Greene Co., Pa. At this point its base comes approximately 840 feet above the top of the Pittsburg coal, and it has the same interval above the latter at Littleton.

It is greenish gray in color, of medium size grain, and more or less micaceous, and has been quarried quite extensively at Littleton for building purposes. A more detailed description of this quarry will be given on a subsequent page under the subject of "Building Stone."

This same rock has been quarried 2 miles below Hundred, on the north side of the B. & O. R. R., in the eastern edge of Clay district, where its base comes 110 to 115 feet above the Jollytown coal and nearly 125 feet vertically above another quarry in the **Hundred sandstone.** It forms con-

spicuous bluffs and cliffs, along the steep hillsides of a great portion of Wetzel county, as well as southeastern Marshall, but was not positively identified in Tyler.

At Burton, Wetzel county, this rock forms a steep slope and its base is nearly flush with the top of the Moses Bartrug core test well (W 25), ⅛ mile northeast of town, in which the Pittsburg coal was struck at a depth of 855 feet. In the southeast portion of Center district, Wetzel, near the head of Sugar run at Anthem, it is quite massive and crops just above creek level. In the same district, near the head of Knob fork, and ¼ mile due south of Jolliffe, this sandstone crops just above the level of a small stream on the land of Jacob Brookover where it has been quarried to some extent for building purposes. At this point its base comes 840 feet above the top of the Pitsburg coal. This sandstone is very massive in Proctor district on the tributaries of Proctor creek. At the mouth of Mud run of Proctor creek it makes a cliff whose base is 40 feet above creek level. The great cliff rock 1 mile northeast of Marion P. O. appears to represent this horizon. On McCloud run, ¾ mile due south of Marion, the base of this cliff rock comes 15 feet above the top of the Anna Brachbuhlar No. 1 well (W 283), in which the Pittsburg coal was found at a depth of 780 feet. This would give an interval of 795 feet to the Pittsburg coal as opposed to 840 feet in Clay, Center and Church districts, Wetzel county. At this point the interval between the Nineveh and Pittsburg coals is about 925 feet as against 990 feet at Burton, 18 miles due east. In Magnolia district, Wetzel, 2½ miles southwest of New Martinsville, occurs a great vertical cliff 45 to 50 feet in heighth and 385 feet above the level of the Ohio river. Its base comes 285 feet above the Washington coal and about 70 feet above the Jollytown coal, thus making it probably the Fish Creek sandstone. It also appears to be this stratum that forms the great cliff on the head of Pt. Pleasant creek, 2 miles due south of New Martinsville on the land of J. W. Krebs. The Fish Creek coal 10" thick, comes at its base. At many other points in Wetzel massive sandstones occur near this horizon but on

account of the close proximity of the Burton sandstone above and the Rush Run below, it is often quite difficult to determine which of the three is represented in a single exposure.

In Liberty district, Marshall county, near Balls P. O., the Fish Creek sandstone, 25 to 30 feet in thickness, crops a short distance above creek level. In the Middle Grave creek section on page 83, the 11½ feet of flaggy sandstone 65 feet below the Nineveh coal probably represents the Fish Creek.

The Fish Creek Coal.

Immediately under the great Fish Creek sandstone in the vicinity of Littleton, Clay district, Wetzel county, occurs a double bedded coal, ranging from 10 to 18 inches thick. It very much resembles the Dunkard bed at its type locality on Dunkard creek, Greene Co., Pa., where the latter also comes at the base of a massive sandstone that has many of the characteristic features of the Fish Creek, a short distance above, and for this reason this coal has heretofore been called the Dunkard. A glance at the Littleton section and comments thereon immediately following, will suffice to show taat the Dunkard seam comes 65 feet lower in the measures. This would leave the coal bed at the base of the Fish Creek sandstone without any name. For reasons already given along with the Littleton section the writer has termed this bed the **Fish Creek coal.** The following partial section down the hill road to the north at the upper end of Littleton will show its relation to the Dunkard and Jollytown coals below:

				Ft.
Massive sandstone (quarry rock), **Fish Creek**				35.0
Shale				3.6
Coal	0′	5″		....
Shale	0	1	**Fish Creek** (1100′ A. T.)	1.0
Coal	0	6		
Interval				65.0
Coal	0′	4″		
Shale	0	2	**Dunkard**	0.7
Coal	0	2		
Interval				51.0
Coal, Jollytown, black slate				1.0
Upper Washington Limestone				2.5

It appears to be the Fish Creek coal that crops on the north side of the road on Church fork, 1 mile east of Hundred, a short distance west of the Samuel Himelrick No. 1 well (W 18) where it has the following section:

	Ft.	In.
Coaly shale	0	1
Gray shale	0	2
Coal, slaty	0	2½
Total	0	5½

Along the edge of the public road leading northeast from Burton its horizon appears to be represented by a few inches of fire clay at the base of the Fish Creek sandstone and it is almost flush with the top of the Moses Bartrug core test well (W 25) a short distance above, making its interval above the Pittsburg coal about 845 to 850 feet. Its horizon was concealed in the Burton hill section. About 2 miles west of Hundred, on Stottlemire run, a short distance below the Peter Kiger No. 1 well (W 60), this coal was once mined for domestic use by Mr. Kiger who said it was 18 inches thick. At this point it comes 850 feet above the Pittsburg coal. Along the road leading up the hill from mouth of Roberts run of Long Drain, 2½ miles southwest of Hundred, the blossom of this coal is exposed at about 1070′ A. T. 45 to 50 feet above the Dunkard bed. It crops at creek level 2 miles west of Earnshaw at 835 feet above the Pittsburg seam where the following section was measured:

			Ft.	In.
Sandstone, visible, Fish Creek			5	0
Sandy shale			5	0
Shale, with fossil plants			4	0
Coal, slaty	0′	1″		
Shale, gray and hard	0	8	1	0
Coal, slaty	0	3		
Fire clay and red shale to creek			5	0

On Sugar run, just east of the corner of Church, Clay, and Center districts, Wetzel county, this coal crops at edge of the public road where it has been mined for domestic fuel, coming as it does at 1110′ A. T. and 845 feet above the Pittsburg bed. A sample of this coal was collected by the writer

at this place for analysis. The seam contained 15 inches of good, fairly clean coal without any partings. Prof. Hite, Chief Chemist of the Survey, reports on this sample as follows:

Proximate Analysis.	Per cent.	Ultimate Analysis.	Per cent.
Moisture	0.80	Carbon	70.91
Volatile matter	39.90	Hydrogen	4.30
Fixed carbon	43.05	Oxygen	4.42
Ash	16.25	Nitrogen	0.92
		Sulphur	3.20
		Ash	16.25
Total	100.00	Total	100.00

	Per cent.
Sulphur	3.20
Phosphorus	0.098

Calorific value:

Calorimeter B. T. U	13,018
Calculated B. T. U.	12,767

$$\frac{\text{Carbon}}{\text{Oxygen}+\text{Ash}} = \frac{70.91}{20.67} = 3.43$$

One mile and a quarter east of this point near the foot of the hill road at Joliff the blossom of this coal shows below the base of a massive sandstone. It appears to be this same coal that crops ⅓ mile due south of Joliff where it has been mined to some extent for fuel on the McMasters farm. It also appears to be this coal that crops along the road leading down Bat run to near the mouth of Sugar run, 1 mile due west of Littleton where the coal is 12 to 16 inches thick and has an elevation of about 1010′ A. T. It appears to be this coal that comes at the base of the great cliff rock on the head of Point Pleasant creek, 2 miles due south of New Martinsville, Wetzel county, on the land of J. W. Krebs where the following section was exposed:

	Ft.	In.
Massive, sandstone, Fish Creek	35	0
Shale, gray	0	4
Coal,, good, Fish Creek	0	10
Slate, black	0	2
Fire clay		

On the river hill front, 2½ miles southwest of New Martinsville it appears to be this coal that comes at the base of a great vertical cliff 385 feet above the river. A partial section here descending shows as follows:

	Ft.	In.
Massive sandstone, forming vertical cliff	47	6
Shale, sandy 0′ to	5	0
Coal, Fish Creek 2″ to	0	6
Interval	68	0
Coal, Jollytown	3	2

This section would show a decrease of the interval between the Jollytown and Fish Creek coals at Littleton, from 116 feet to 68 feet.

About one mile and a half below Wileyville in the extreme southern portion of Proctor district, Wetzel, a coal was once mined on the south side of Little Fishing creek, on the land of Lucinda Kirtland about 100 feet above the bed of the stream. The opening had fallen in but the coal was said to be 2 feet thick. A large refuse dump indicated that a considerable quantity of coal had been mined here to supply fuel to the farmers in the surrounding neighborhood before the building of the Short Line Branch of the B. & O. R. R. What appears to be this same seam is exposed on the land of Dr. T. M. Haskins along Pine run, a stream putting into Little Fishing creek from the north at Halls Mills. A section measured here showed as follows:

				Ft.	In.
Sandstone, massive, friable, **Fish Creek**				10	0
Shale, dark gray				7	0
Coal	0′	8″	} Fish Creek	1	5
Slate, black	0	2			
Coal, slaty	0	7			

The **butts** run S. 45° E., and the **faces** N. 45 E.

In Marshall county, Liberty district, this coal crops just above stream level on Harts run near Balls P. O., 2½ miles northeast of Bellton (Denver Sta.) where it has been mined for local domestic fuel. Its elevation here is about 1055′ A. T.,

coming approximately 835 feet above the Pittsburg coal. A section there shows as follows:

				Ft.	In.
Massive sandstone, **Fish Creek**				25	0
Coal	0′	8″			
Slate, gray	0	1	**Fish Creek**	1	6
Coal	0	9			
Limestone, gray and hard				2	0

This is the greatest thickness found for this coal in the entire area, and is the first time a limestone has been noted so close below. In the section made on Middle Grave creek, Marshall county, the blossom of this coal appears to be represented 68 feet below the Nineveh coal.

The Rush Run Sandstone.

At 35 to 40 feet below the Fish Creek coal and immediately over the Dunkard coal in the vicinity of Littleton and Hundred, Wetzel county, occurs a massive sandstone ranging from 10 to 25 feet in thickness, that resembles in color and structure the Fish Creek rock above. In fact, this sandstone at the type locality of the Dunkard coal, on Dunkard creek, Greene Co., Pa., is quite massive and was thought to be the Fish Creek sandstone when the type section of the Dunkard series was published by Dr. I. C. White, a copy of which is given on page 126 of this report. The Littleton section shows the Dunkard coal coming 65 feet below the Fish Creek sandstone. This situation leaves the stratum, coming directly over the Dunkard coal without any name, so the writer has termed it the **Rush Run sandstone** from its exposure directly over the undoubted Dunkard coal near the mouth of a stream of that name emptying into Fish creek, ¾ mile southeast of Hundred, Wetzel county. From the mouth of Rush Run southeast to Burton this rock forms a steep bluff on both hillsides, and at the latter point passes below drainage. On Church fork to the north it is exposed along the road ⅓ mile east of the mouth of Cappo run. In Center district, Wetzel, this rock forms a cliff directly over the Dunkard coal ⅓ mile up from the mouth of Rocky run, 3¾ miles northwest of Littleton. In Clay district, Wetzel, near the head

of Browns run this sandstone is quite massive and crops just above stream level, 1 mile south of the W. Va.-Pa. State line.

In Marshall county this sandstone outcrops in the railroad cut, ½ mile west of Loudenville. In the Glen Easton section its horizon is represented by 20 feet of friable sandstone and sandy shale 8 feet above the Dunkard coal horizon. This stratum was not definitely recognized in Tyler county.

It is not quite as massive and does not appear to be as persistent as the Fish Creek sandstone above.

The Dunkard Coal.

From a few inches to 20 feet below the Rush Run sandstone occurs a double bedded coal seam, named the **Dunkard** by Prof. J. J. Stevenson from its outcrop on Dunkard creek, Greene Co., Pa., where it comes 750 feet above the top of the Pittsburg bed, and 35 to 45 feet above the Jollytown coal. At Burton, Hundred, and Littleton, Wetzel county its intervals above the Pittsburg coal are 765 feet, 770 feet, and 775 feet respectively. At Littleton it comes 65 feet below the Fish Creek coal and 235 below the Nineveh bed. Owing to its double-bedded nature and its occurrence at the base of a massive sandstone, this coal was placed at the base of the Fish Creek sandstone by Professors Stevenson and White, and was supposed to be identical with the coal mined at the base of this great sandstone near Deep Valley, Springhill township, Greene Co., Pa. The Littleton section and comments thereon on page 148 of this report will suffice to show that the coal near Deep Valley belongs 65 feet higher up in the measures.

This seam varies from 6 to 18 inches in thickness and nearly always carries a parting slate from ½ to 2 inches thick near the middle. Just before it passes below drainage at the west end of Burton, Wetzel county, about 100 yards below the residence of Elihu Lemley, the writer made the following section on the southwest side of the creek on the land of Mrs. S. A. McFarland:

				Ft.	In.
1	Massive sandstone, visible, **Rush Run**			15	0
2	Shale			9	0
3	Shale with fossil plants			1	0
4	Coal	0′	1″		
5	Shale, gray	0	4		
6	Coal	0	1		
7	Shale, gray	0	3½	2	0
8	Coal and shale	0	7		
9	Shale, gray	0	0½		
10	Coal	0	7		
11	Slate, black			0	2
12	Fire clay and shale			7	0
13	Limestone, very silicious			1	6
14	Shale to creek level			4	6

At this point the coal comes 770 feet above the Pittsburg coal as shown by the log of the W. C. Whitlatch No. 1 gas well (W 26) just opposite. The writer collected a sample of the bottom portion for analysis on which Mr. J. H. Krak, Asst. Chemist of the Survey reports as follows:

Proximate Analysis.

	Per cent.
Moisture	1.53
Volatile Matter	32.08
Fixed Carbon	42.71
Ash	23.68
Total	100.00
Sulphur	7.24
Phosphorus	0.24

Ultimate Analysis.

	Per cent.
Carbon	55.90
Hydrogen	6.20
Oxygen	6.10
Nitrogen	0.88
Sulphur	7.24
Ash	23.68
Total	100.00

Calorific value:
Calorimeter, B. T. U.
Calculated B. T. U. 11,535

To the northwest from Burton thhe Dunkard coal crops along the north edge of the public road in Church fork, ⅓ mile east of the mouth of Cappo run where it has the following section:

	Ft.	In.
Coaly shale	0	1
Gray Shale	0	2
Coal, slaty	0	2½
Total	0	5½

It was not noted on the detailed log of the Sarah Anderson

No. 1 well (W 1) published in connection with the Burton section, but was found in the Moses Bartrug core test (W 25), ⅓ mile northeast of Burton at a depth of 90 feet where it had a thickness of 18 inches as reported by the driller, coming 765 feet above the Pittsburg coal and 147 feet below the Hostetter coal, the latter outcropping 57 feet (hand level measurement) above the top of the test at this point. In Clay district, Wetzel, the Dunkard coal is exposed on Browns run, 1 mile south of the W. Va.-Pa, State Line, just above the level of the creek at an elevation of about 1080′ A. T. At Littleton along the hill road to the south from the upper end of town this coal shows as follows:

	Ft.	In.
Coal	0	4
Shale, gray	0	2
Coal	0	2
Total	0	8

This coal is exposed in the bed of Stottlemire run 2 miles west of Hundred at an elevation of near 1055′ A. T. where the writer measured the following section of this bed:

		Ft.	In.
Coal	0′ 1″		
Shale, gray	0 8		
Coal	0 1	1	0
Shale, gray	0 1		
Coal	0 1		
Fire clay and shale		8	0
Limestone, gray and hard		0	10

It appears to be this coal that crops on Long Drain near the creek at the mouth of Roberts run. A short distance above this point the coal is exposed along the road at about 1030′ A. T. where it had the following structure:

	Ft.	In.
Coal, shaly	0	6
Dark gray shale	0	4
Coal	0	4
Total	1	2

From this point the rocks appear to be rising up Long Drain to the summit of the Hundred anticline and at Earnshaw its outcrop is exposed in the rear of J. F. Hughes store at an elevation

of 1092′ A. T. where it is badly split up with shales, the whole having a thickness of 18 inches. About 2½ miles southwest of Earnshaw, near the foot of the hill road at the head of Morgan run in the northeast corner of Grant district, Wetzel county, 3 inches of coaly shale is exposed at an elevation of near 1080′ A. T. This shale appears to come at the horizon of the Dunkard bed. In the northeast corner of Center district, Wetzel, ⅓ mile up from the mouth of and on Rocky run, what appears to be the Dunkard coal has been mined by a farmer for domestic fuel. At the point where opened it is 15 to 18 inches thick, but thins out both up and down stream within a few yards to only a streak. It appears to be this coal that crops along the road leading down Little Fishing creek from Wileyville to Halls Mills in the southern part of Proctor district, Wetzel, where it comes about 700 feet above the Pittsburg bed as shown by J. Lock Kirtland No. 1 well (W 277). Along this road it is only 2 to 3 inches thick. On the south side of Little Fishing, ¾ mile east of Halls Mills is an old abandoned opening in what appears to be the Fish Creek coal, and the Dunkard bed is exposed in the road nearly opposite and about 85 feet lower in the measures. A section here showed as follows:

		Ft.	In.
1	**Coal, Fish Creek, (old mine)**	2	0
2	Concealed	45	0
3	Sandstone, friable, **Rush Run**	38	0
4	Shale	2	0
5	**Coal, Dunkard, slaty**	0	2
6	Concealed to creek	10	0

One mile and a half south of Folsom in the southeast corner of Grant district, Wetzel, this coal crops along the road leading up Trader fork where the following section is exposed:

			Ft.	In.
1	Sandstone, massive, Rush Run		15	0
2	Concealed		10	0
3	Shale, sandy		5	0
4	Coal ..... 0′ 2″			
5	Shale, gray.... 0′ 8″	**Dunkard**	1	2
6	Black shale... 0′ 4″			
7	Concealed			

At this point it is approximately 975′ A. T., coming 770 feet above the top of the Pittsburg coal as shown by the log of the Taylor Ruble No. 1 well (W 214), a short distance above.

In Marshall county this coal was identified at several points In the section measured by the writer one mile southwest of Bellton it appears to be this bed that comes 630 feet from the top of the section, coming about 715 feet above the Pittsburg coal. It had the following structure at this point:

	Ft.	In.
Black slate .... 0′ 2″ Coal ..... 0′ 3″ Shale, gray .... 0′ 0½″ Coal, good .... 0′ 1″	0	6½

The northwestward thinning of the measures has reduced the interval between it and the Pittsburg bed about 60 feet from that at Littleton, in the 4½ miles air line distance. A coal is exposed in a railroad cut, ½ mile west of Loudenville, coming about 1030′ A. T., which appears to represent the Dunkard. A section here showed as follows:

	Ft.	In.
Sandy shale	6	0
Shale, gray and soft	2	0
Coaly shale ..... 0′ 4″ Coal, good ..... 0′ 2 ½″ Shale, gray ..... 0′ 1 ½″ Coal, good .....0′ 5 ½″	1	½
Fire clay and red shale	10	0
Sandstone, flaggy and concealed to R. R. grade	15	0

At Glen Easton this bed is represented by 12 inches of slaty coal, coming 35 feet above the Jollytown seam. On Wheeling creek its horizon along the hill road leading to the north, 2 miles west of Majorsville, appears to be represented by 1 foot of dark shale, 35 to 40 feet above the Jollytown coal and approximately 630 feet above the Pittsburg bed. In the Middle Grave creek Section, page 83, its horizon is represented by 10 inches of slaty coal 130 feet below the Nineveh bed.

It was not definitely recognized in Tyler county and appears to have thinned away before reaching this area.

The Jollytown Sandstone.

In the 30 to 50 feet of measures that intervene between the Dunkard coal and the Jollytown coal next below, there often occurs a massive sandstone, coming 5 to 10 feet above the latter

coal, and hence the writer has given it the name, **Jollytown sandstone.** It is nearly always present and ranges in thickness from 5 to 30 feet. This stratum is well exposed 5 feet over the Jollytown coal on the north side of the public road, ¾ mile southeast of Hundred, Wetzel county, where it is 10 feet thick and quite massive. Also at the east portal of Soles tunnel, one mile and a half below Hundred, Wetzel county, where it is 25 feet thick, quite massive, and has cut away the Jollytown coal and part of the Upper Washington limestone. Sometimes it is quite flaggy and friable, and at other times its horizon is represented by only a bed of sandy shales. It has never been quarried for building purposes within the area under discussion so far as known to the writer. At the type locality of the Jollytown coal on Dunkard creek, ½ mile due east of Hero P. O., Greene Co., Pa., this sandstone is 10 to 15 feet thick and quite massive, coming 10 to 15 feet above the Jollytown coal.

The Jollytown Coal.

From 30 to 50 feet below the Dunkard coal occurs another bed that was named the Jollytown coal by Professor J. J. Stevenson from its outcrop in a village of that name in Greene county, Pa. It has been mined by stripping from the bed of Town run at that place on the land of J. P. Hagan where the writer measured the following section:

		Ft.	In.
1	Bone coal.. 0′ 4″		
2	Coal, good.. 0′ 7″	0	11
3	Shale, limy	0	6
4	Limestone, gray and silicious, in layers		
	Upper Washington	3	0

A sample for analysis was collected from the bottom portion, the composition of which Mr. Krak, Asst. Chemist of the Survey reports as follows:

Proximate Analysis.

	Per cent.		Per cent.
Moisture	1.12	Carbon	55.28
Volatile matter	29.38	Hydrogen	5.58
Fixed carbon	43.70	Oxygen	9.19
Ash	25.80	Nitrogen	1.01
		Sulphur	3.14
		Ash	25.80
Total	100.00	Total	100.00

	Per cent.
Sulphur	3.14
Phosphorus	0.11

Calorific value:

Calorimeter B. T. U.	———
Calculated B. T. U.	10,939

It is well exposed along the north side of the road leading up Church fork, ¼ mile northeast of Hundred, Wetzel county, where the writer measured the following section descending:

		Ft.	In.
1	Sandstone, flaggy and friable	10	0
2	Shale, dark, slaty	4	0
3	Bituminous slate.. 0′ 4″		
4	Coal 0′ 4″	0	8
5	Fire clay and gray shale	1	0
6	Limestone, blue and hard, weathering yellowish, Upper Washington	2	9
7	Shale, limy with limestone, nodular to road	5	0

Its elevation here is about 1040′ A. T., coming 740 feet above the Pittsburg bed as shown by the T. B. Hamilton No. 1 gas well (W 19). This section is almost a duplicate of that given above for this coal at Jollytown, 7¾ miles N. 67° E. of Hundred. The interval above the Pittsburg coal at the latter place is 30 to 40 feet greater than at the former. It is also well exposed ¾ mile northeast of Hundred, on the left side of the road leading up Cappo run of Church fork where about the same section is exposed. From the mouth of Cappo run it is dipping rapidly up both the latter and Church fork on the eastern flank of the Hundred anticline, soon passing below drainage. It is exposed at the mouth of Rush Run, ¾ mile southeast of Hundred, at an elevation of 1034′ A. T. (spirit level measurement), coming 725 feet above the top of the Pittsburg coal as

shown by the log of the Geo. F. Throckmorton No. 1 well (W 22) near by. Four to five inches of slaty coal occurs here directly over 2 to 3 feet of limestone, easily observed at the south end of the bridge over Fish Creek at this place.

This coal bed is also exposed along the public road at the west end of Hundred where it is represented by 3½ inches of slaty coal, coming directly over a limestone at an elevation of 1020′ A. T.

In the Sarah Anderson No. 1 well (W 1) on Church fork of Fish creek, 1 mile north of Burton, this coal was struck at a depth of 98 feet and reported 2 feet thick by the drillers. Its interval above the Pittsburg bed in this well is 734 feet. It has a slight dip west from Hundred, and passing on down Fish creek, its horizon is exposed at the east end of Soles tunnel, but the coal itself has been cut away in the deposition of the overlying Jollytown sandstone. Its horizon is also well exposed over the great quarry midway between Soles and Marshall tunnels where the following section was measured by the writer descending:

	Ft.	In.
Shale	5	0
Bituminous slate, Jollytown coal	0	10
Limestone, gray and silicious, Upper Washington	4	0
Shale, limy, gray	5	0
Massive sandstone quarry rock, **Hundred**	30	0
Coal, Hundred	0	3
Shale to R. R. grade	2	

The upper part of this section is almost a duplicate of the exposure at Hundred, 2 miles eastward, except that the 4 inches of bituminous slate at the latter point has here thickened up to 10 inches and replaced the 4 inches of coal. Almost a duplicate of this section is exposed at the east end of Marshall tunnel where the coal is represented by 10 inches of **bituminous slate,** coming directly over 3½ feet of limestone at an elevation of about 1020′ A. T. as opposed to 1035′ A. T. at the stone quarry where the above section was made, the latter point being on the crest of the Littleton anticline. The coal still continues to dip northwest down the slope of the Littleton anticline and is exposed a few feet above the roof of the east portal of Martin tunnel, just below the mouth of Long Drain, ½ mile east of

Littleton at an elevation of 982′ A. T., where the following section is exposed:

	Ft.	In.
Coal, Dunkard, with parting	0	8
Sandy shale, yellowish and red	41	0
Sandstone and sandy shale **Jollytown sandstone**	10	0
Bituminous slate, Jollytown coal	1	0
Limestone, gray and silicious, Upper Washington	2	6
Shale, limy	12	6
Sandstone	5	0
Shale, red to R. R. grade	10	0

The Jollytown coal continues to dip down stream from Littleton, and at the mouth of Boardtree run, the stream up which the B. & O. R. R. passes on leaving the W. Va. fork of Fish creek, has fallen to 930′ A. T. where it was once opened up. The following section is exposed here:

		Ft.	In.
1	Sandstone, flaggy, **Jollytown**	10	0
2	Shale, dark	4	0
3	**Coal, Jollytown**	0	4
4	Fire clay and shale	5	0
5	Limestone, gray and hard, visible	1	6
6	Concealed to road	7	6

The bituminous slate has been replaced by 4 inches of coal.

In Grant district, Wetzel, on Willey fork of Little Fishing creek, this coal is exposed along the road, ½ mile southeast of Burchfield and has the following structure:

		Ft.	In.
1	Coal	0	1½
2	Shale, gray	0	4
3	Coaly streak	0	0½
	Total	0	5¾

Its elevation is about 925′ A. T., coming near 625 feet above the Pittsburg coal. This interval seems so much less than at Littleton, 9 miles to the northeast, that it may be this coal represents the bed coming directly under the quarry rock (Hundred sandstone), 40 to 50 feet below the Jollytown seam. The latter is, however, one of the most persistent beds of the Dunkard series, and in addition the measures appear to thin southwestward probably enough to bring the interval down to the figures given.

In the same district on Richwood run, 2½ miles due east of Jacksonburg, 4 inches of coal crops a few feet higher than the A. L. Wyatt No. 1 well (W 168), coming about 895′ A. T. and 645 feet above the Pittsburg bed. In the Pine Grove section it is represented by 2 inches of coaly slate coming 643 feet above the latter bed. It also appears to be this bed that crops along the road leading east up the hill from Piney in Green district, Wetzel, where it is 2 inches thick, coming 625 feet above the Pittsburg Coal. In the extreme northern edge of the same district, 1 mile southwest of Halls Mills, near the mouth of Coal run, a small stream putting into Little Fishing, ¼ mile below Blen run, a coal has been mined for domestic use that appears to represent the Jollytown bed, coming as it does 630 to 650 feet above the Pittsburg seam, and 780′ A. T. The writer measured the following section at this place:

		Ft.	In.
1	Sandstone, visible	2	0
2	Shale, sandy	15	0
3	**Coal, good, Jollytown**	2	0
4	Slate, black	1	0
5	Shale, to run level	12	0

The coal looks quite pure and has been mined along both sides of this stream. There is a marked local rise to the southeast. This coal is also exposed about midway between the mouths of Coal and Blen runs where the following structure is exhibited:

		Ft.	In.
1	Coal, slaty	0	3
2	Shale, gray	1	4
3	Slate, with streaks of coal	0	2
4	Gray shale	0	3
5	Slate, with streaks of coal	0	2
6	Coal, good	1	3
	Total	3	5

This section is quite different from the one above and shows the tendency of this bed to split up more or less as it approaches the Ohio river in Wetzel county.

In Proctor district, Wetzel, the Proctor Creek section on page 98 shows a fire clay horizon 181 feet above the Washington coal and 590 feet above the Pittsburg bed that probably

represents the horizon of the Jollytown coal, coming as it does 238 feet below the Nineveh limestone as opposed to 280 feet for the same interval at Littleton. In the extreme northern portion of Magnolia district, Wetzel, on the river front, it is well shown by the Steelton section on page 156, coming about 140 feet above the Washington bed. Its structure here is as follows:

	Ft.	In.
Coal	0	4
Slate, gray	0	1
Coal	0	6
Total	0	11

In the section measured at the mouth of Coal fork of Doolin run, page 99, its horizon is represented by fire clay over a limestone, coming 205 feet below the Nineveh coal and 192 feet above the Washington bed. In the section measured by hand level down the river hill, 3 miles southwest of New Martinsville, this coal is badly split up, coming 199.4 feet above the Washington coal and nearly 70 feet below the Fish Creek bed. Its structure at this point is as follows:

		Ft.	In.
Coal, slaty	0′ 9″		
Coal	0′ 5″		
Slate, gray	0′ 4″		
Coal, slaty	0′ 8″	3	2
Coal	0′ 6″		
Slate, black	0′ 6″		
Shales, limy		9	0
Limestone, hard, silicious, **Upper Washington**		1	0

In Marshall county, the Jollytown coal is found outcropping at a number of points. On the south side of Fishing Creek, ½ mile below Bellton (Denver Station), this coal crops 20 to 25 feet above the stream at an elevation of nearly 900′ A. T. where the following section is exposed:

	Ft.	In.
Coal	1	1
Shale, limy	12	0
Limestone, **Upper Washington**	4	0

It rises as it passes up Harts run, just below Bellton, and is exposed in a railroad cut, ½ mile due north of the town at an elevation of 918′ A. T., coming 635 feet above the Pittsburg coal as shown by the log of the Marshall County Bank (H. S.

White), No. 1 well (M 121) near by on the east. One mile and a half southwest of Bellton, on the W. Va. fork of Fish creek, this coal was once mined on the east bank, ½ mile below the mouth of Hickman run, where it was reported to be 1 foot thick. Its horizon is concealed there now. According to the log of the W. V. Hoge No. 1 well (M 126), this coal comes 638 feet above the Pittsburg bed. The blossom of this coal is exposed along the public road leading up the Pennsylvania Fork of Fish creek, ½ mile northeast of Kausooth. On the east side of the creek at Kausooth this bed is exposed at the side of the public road where the following section is exhibited:

		Ft.	In.
1	Concealed	40	0
2	Shale	30	0
3	**Coal, Jollytown**	0	8
4	Shale	2	0
5	Limestone, Upper Washington	4	0
6	Concealed	30	0

Passing on down Fish creek to the forks of the public road, ¼ mile below the mouth of Cedar run, 11 inches of coal is found cropping along the road leading north onto "Big Run Ridge," where the following section is exposed:

		Ft.	In.
1	Concealed	20	0
2	Shale	8	0
3	**Coal, good, Jollytown**	0	11
4	Shale	2	0
5	Limestone, hard, yellowish, Upper Washington	4	0

The coal has an elevation here of about 840′ A. T. In the Graysville section, page 91, at the mouth of Fish creek, the 4 inches of slaty coal, coming 161 feet below the Nineveh limestone and 537 feet above the Pittsburg coal, appears to represent the Jollytown bed. On the head of Grave creek, 2.3 miles north of Cameron, 3 inches of **black slate** is exposed directly over a hard, blue silicious limestone. It is located near the C. S. Frye No. 1 well (M 35). At the fork of the road, ¾ mile southeast of this point and 1 mile west of the E. P. Lough No. 1 well (M 36), 4 inches of **black slate** is exposed at an elevation of 1095′ A. T. that appears to represent the Jollytown coal,

coming about 670 feet above the Pittsburg bed. A section here showed as follows:

	Ft.	In.
Sandstone, flaggy, Jollytown	15	0
Shales	5	0
Black slate, Jollytown coal	0	4
Shale	1	6
Limestone, blue and hard, Upper Washington	1	3

This coal is exposed in a R. R. cut, ¼ mile east of Glen Easton, coming about 625 feet above the Pittsburg and 975′ A. T. A., section here gave the following exposures.

			Ft.	In.
1	Concealed		6	0
2	Sandstone		3	0
3	Sandy shale		15	0
4	**Slate, black, Jollytown coal**		0	6
5	Limestone 0′ 6″	Upper		
6	Limy shale 3′ 0″	Washington	7	6
7	Limestone, gray and hard 4′ 0′			
8	Shale, reddish		6	0
9	Sandstone, friable, **Hundred**		3	0
10	Shale to R. R. grade		9	0

At Glen Easton, this same black slate comes about 30 feet below the blossom of the Dunkard coal. At Rosbys Rock this coal is exposed along the road leading southwest from the town, where it is represented by 6 inches of slaty coal, coming at an elevation of about 1050′ A. T., 225 feet above the Washington coal, and 635 feet above the Pittsburg bed.

In the Middle Grave creek section, page 83, the 10 inches of slaty coal, coming 130 feet below the Nineveh bed, may represent the Jollytown. In the Majorsville section on Wheeling creek, page 80, its blossom comes 154 feet below the Nineveh limestone, 39 feet below the Dunkard coal, 161 feet above the Washington coal, and about 585 feet above the Pittsburg bed. This shows a very marked thinning of the measures of the Dunkard series in the 18 miles distance due northward from the Littleton region.

In Tyler county, the Jollytown coal is not so positively identified as in Wetzel and Marshall to the north. The underlying Upper Washington limestone, so generally associated with this bed in the latter counties, appears to thin out entirely before reaching Tyler, making it more difficult to determine the

true horizon of the Jollytown seam. In Lincoln district on the north side of Saltlick run, ¾ mile southwest of Pursley, a coal that appears to be the Jollytown is at present being mined on the land of Wm. Bruce, coming about 900′ A. T., 130 to 140 feet above the Washington coal, and about 535 feet above the Pittsburg as revealed by the log of the Aaron Scannahorn No. 1 well (T 32), on the assumption that the interval from the top of the Pittsburg coal to the Big Injun sand is 1185 feet, 5 to 10 feet greater than at Sistersville, or practically the same as in the A. Heinzman No. 1 well (T 34). A section measured at the Bruce opening gives the following:

	Ft.	In.
Coal, slaty	0	2
Coal, good	0	11
Slate, gray	0	0¼
Coal	1	6
Slate, gray	0	1
Coal, 1″ to	0	2
Total	2	10¼

The writer collected a sample at this mine for analysis, the composition of which Mr. Krak, Asst. Chemist of the Survey, reports as follows:

Proximate Analysis.

	Per cent.
Moisture	1.00
Volatile matter	34.72
Fixed carbon	48.26
Ash	16.02
Total	100.00

Ultimate Analysis.

	Per cent.
Carbon	65.58
Hydrogen	6.47
Oxygen	4.88
Nitrogen	0.66
Sulphur	6.39
Ash	16.02
Total	100.00

	Per cent.
Sulphur	6.39
Phosphorus	0.04

Calorific value:

Calorimeter B. T. U. ..... 12,309.
Calculated B. T. U. ..... 13,431.

This coal has practically all been mined out from the top of the hill just west of Pursley according to J. B. Hissom, the black-

smith at the latter place, where it was known as the Lewis bank, and who states that it ran from 3 to 4 feet thick. The coal has a marked dip to the southeast and is immediately overlaid by a very massive sandstone 20 to 30 feet in thickness, which would appear to represent the Jollytown sandstone. The Washington "A" coal crops at the bridge at the foot of the hill road leading to the southeast from Pursley, and the interval between the latter bed and the coal mined in the top of the hill is 86 feet as measured by hand level. This thickening up of the Jollytown bed appears to be confined to the Pursley region, since in every direction from this locality its horizon, where exposed along the roads is sometimes represented by only a dark streak along with a few inches of fireclay.

On the ridge road at the head of Cow Hollow run in Lincoln district, Tyler, 2½ miles south of Sistersville, 5 inches of slaty coal with ¼ inch of gray shale 2 inches above bottom, crops a short distance southwest of the cross roads at an elevation of 964′ A. T. This appears to represent the Jollytown bed as the westward rise of the rocks on the slope of the Sistersville anticline would bring the coal up to about this elevation from the mine on the Bruce farm on Saltlick, one mile and a half due east, where it has an elevation of 900′ A. T.

The fire clay horizon, 35 feet from the top of the Sistersville turnpike section, page 121, may represent the Jollytown coal, coming as it does 523 feet above the Pittsburg coal, nearly the same interval as the coal mined at Pursley. A coal was once mined 3 miles southwest of Middlebourne near the top of the hill on the Rebecca Ash farm on Little Sancho creek on the south side and ½ mile up from the mouth of the latter, that appears to represent the Jollytown coal. A section measured by the writer at one of the old openings showed as follows:

		Ft.	In.
1	Sandstone, massive		
2	**Coal, Jollytown (?)**	3	4
3	Concealed		

This shows an unusual thickness for these higher Dunkard beds. Mr. O. D. Ash of Locke, W. Va., gives the following section of the coal, etc., as exposed at one of these openings:

		Ft.	In.
1	Massive sandstone	15	0
2	**Coal, with clay seams**	6	0
3	Slate, black and hard 6″ to	1	0
4	Fire clay.		

Mr. Ash says the opening, now fallen in, had been carried back in for about 30 feet where the coal had thinned down to only 4 feet. Several clay seams run vertical through the coal. This coal comes about 130 feet over the Washington bed, and if not either the Jollytown or Washington "A", it may possibly represent the Hundred coal, coming 50 feet under the Jollytown bed on Fish creek, 2 miles below Hundred, Wetzel county. The 10 inches of dark shale over fire clay, cropping in road near the cross roads, 1 mile northeast of Wilbur in McElroy district, may represent the Jollytown coal horizon, since it comes about 140 feet above the Washington bed in this region.

The Washington Limestones.

In the region of Washington, Pennsylvania, three important limestones are found in the interval between the Jollytown and Washington coals. These have been designated the **Upper, Middle** and **Lower Washington** limestones by Prof. J. J. Stevenson from that locality.

The **Upper Washington Limestone** is found just under the Jollytown coal, sometimes separated from the latter by only a few inches of limy shale. Prof. Stevenson[12] gives the following description of this stratum in the Pennsylvania region:

"The Upper Washington limestone is a fine stratum of such marked characteristics that it cannot be mistaken for any other in the series. In all portions it weathers to an almost snowy whiteness with the slightest tinge of blue. The upper part is quite slaty and is blue on the freshly exposed surface. The middle layers are dark, almost black, and frequently mottled with drab. They are exceedingly brittle, ring sharply when struck, and yield a limestone of superior quality.

The top and bottom divisions are persistent, but the middle or dark portion disappears soon after entering Greene county."

12* Second Geol. Survey of Pa., Vol. K., p. 45; 1875.

In Prof. Grimsley's report on Ohio, Brooke and Hancock counties he has the following to say concerning this stratum on page 61:

"In Washington county, Pennsylvania, this limestone reaches a maximum thickness of 30 feet, made up of layers of limestone and shales, while in Greene county it decreases to four and eight feet. In Ohio county, W. Va., this limestone varies from 4 to 8 feet. On the John Hand farm, one mile west of Twilight, this limestone is eight feet thick, very hard, and has the following composition:

	Per cent.
Lime carbonate	92.42
Magnesium carbonate	0.91
Iron and alumina oxides	1.60
Silica	5.00
	99.93

In the Marshall-Wetzel-Tyler area, this limestone has a maximum thickness of 4 feet where found exposed along Fish creek, between Hundred and Littleton. In this section it is quite silicious, bluish gray on fresh fracture, and weathers to a yellowish gray.

This stratum is exposed along the public road leading up Church fork, ¼ mile northeast of Hundred. It forms the bed of Cappo run of Church fork 1 mile N. 70°—80° E. of the same town. Its outcrop is also exposed in the rear of the Hundred Bank Building, and at the mouth of Rush run, ¾ mile to the southeast. Passing down Fish Creek, one mile and a half, it is found exposed again at the east end of Soles tunnel, where the overlying Jollytown sandstone has cut away the top portion of this stratum, and the Jollytown coal entirely. Its outcrop is well exposed 5 feet over the great quarry rock (Hundred sandstone) on the south side of the creek directly opposite the quarry, about midway between Soles and Marshall tunnels. It is also well exposed over the east portal of the latter tunnel as well as at Martin tunnel, ½ mile east of Littleton. In the section made along the Ohio river front, 3 miles southwest of New Martinsville, page 101, 1 foot of hard, gray, silicious limestone occurs 9 feet below a coal that the writer has identified as the

Jollytown. The limestone would appear to represent the Upper Washington.

In Marshall county, at Bellton (Denver Station), this limestone is 4 feet thick, coming 15 to 20 feet above creek level and about 10 feet below the Jollytown coal. This limestone crops along the road leading up the North fork of Grave creek, one mile and a half northeast of Cameron, where it is 12 to 18 inches thick, blue and hard. Further down Grave creek its crop is exposed in a railroad cut, ½ mile east of Glen Easton, coming directly under the Jollytown coal, where it has the following structure:

	Ft.	In.
Limestone, gray and hard	0	6
Limy shale	3	0
Limestone, gray and hard	4	0
Total	7	6

In the Rosbys Rock section, page 143, this limestone is only 3 to 4 inches thick, coming 14 to 15 feet below the Jollytown coal, but in the Wheeling creek region it is found cropping along the road leading to the north from this stream, 2 miles west of Majorsville, where it is 1 foot thick, coming immediately under the Jollytown coal blossom.

This limestone was not recognized in Tyler county and appears to have either thinned away before reaching this area, or to have been replaced by red limy shales so common to the Dunkard series.

The Middle Washington Limestone. This limestone is one of the most persistent rocks of Marshall and Wetzel counties, but appears to be absent entirely in Tyler county. The original description of Prof. Stevenson[13] is as follows:

"As found in Washington county, it is a massive buff limestone from six to fifteen feet thick, when freshly broken, is of dull flesh color and glistens with innumerable bits of calcspar. So great is the quantity of iron present that the rock after long exposure weathers rusty yellow to a depth of several inches and finally, after exfoliation, crumbles. Toward the base there are

13* Loc. cit., p. 49.

some thin earthy layers which have a slaty fracture, and containing less of iron, do not yield so readily to the weather as does the upper portion. The upper or ferruginous part of the bed is richly fossiliferous, but as the fossils are not silicified, it is rarely possible to obtain specimens in identifiable condition."

This limestone is found in numerous sections of Marshall and Wetzel counties, and on fresh fracture is a bluish gray in color, weathering to a white and yellowish gray where exposed. It varies in thickness from 5 to 30 feet, coming 30 to 50 feet above the Washington coal. A quarry was formerly worked in this limestone just north from Marshall in Ohio county, on the county farm west of Elm Grove where Prof. G. P. Grimsley[14] reports the following structure and analysis:

	Ft.	In.	Ft.	In.
Shales, buff	8	0		
Limestone, gray and mottled	1	2		
Limestone, blue, shaly	0	8		
Black, clay shale	0	2		
Limestone, blue, shaly	0	5		
Limestone, blue, irregular fracture	2	0	8	10
Limestone, shaly	0	3		
Limestone, blue and hard	1	8		
Shale, blue	1	0		
Limestone, gray and hard	1	6		
Shale, buff	6	0		

"An average sample of this limestone was taken with the shale layers removed and analyzed in the Survey laboratory with the following results:

	Per cent.
Lime carbonate	72.38
Magnesium carbonate	1.36
Iron and alumina oxides	2.60
Silica	20.90
Water and organic matter	2.65
Total	99.89

"The analysis shows the rock to be a silicious limestone, low in magnesia, iron and alumina."

It becomes more silicious southwest in Marshall and Wetzel. Its outcrop is well exposed at several points along Wheeling

14. Ohio-Brooke-Hancock Report, p. 62. W. Va. Geol. Survey.

creek in northern Marshall. At the mouth of Grandstaff run it is 8 feet thick, gray and hard, coming 36 feet above the Washington coal. At Majorsville, along the hill road leading to the northwest, this stratum is 5 feet thick, coming 30 feet above the Washington coal. On the Ohio river front in Marshall, at McMechen, this limestone is 5 feet thick, coming 37 feet above the Washington coal. The greatest thickness found by the writer in the Marshall-Wetzel-Tyler area, was at its exposure along the hill road leading south from the mouth of Grave creek, where it totals 35 to 40 feet, the top portion being dark and silicious, interstratified with shale; the middle, gray and hard; and the lower 8 feet about one-half dark limy shale, its base coming only 10 feet above the Washington coal. Passing up Grave creek to Rosbys Rock, it is found cropping along the hill road southwest of the town where only 2 feet of its base is visible, coming about 50 to 60 feet above the Washington coal. It passes below drainage on Grave creek about midway between Rosbys Rock and Glen Easton. Passing on down the Ohio river from the mouth of Grave creek to the mouth of Hog run, just above Powhatan station this stratum is found outcropping 35 feet above the Washington coal. At this point it is 10 feet thick and a yellowish gray in color. It crops along the hill road leading to the east from Franklin Station, 1 mile south of the mouth of Fish creek where it is 15 feet thick, and yellowish gray in color, coming 25 to 30 feet above the Washington coal. Along the road leading to the east from Clarington Station only 2 feet of the limestone is visible, coming 45 feet above the latter coal. In the extreme southwestern corner of Marshall, along the hill road to the north, 1 foot of the top portion of this limestone is visible, coming 43 feet above the Washington coal. Its crop is well exposed in the bed of Long run of Fish creek, 3¼ miles S. 10° E. of Graysville where it is 10 to 15 feet thick, coming 25 feet above the Washington coal. About a mile east of Graysville this limestone is well exposed along the road leading northeast from the mouth of Big Tribble creek, where it is 15 feet in thickness, coming about the same interval above the Washington coal. Farther up Fish creek, on the south side of Middle Bowman and ½ mile due east of Meighen P. O., this

limestone is finely exposed, its outcrop coming 41 feet above the top of the T. J. West No. 1 well (M 98), in which the Pittsburg coal was struck at a depth of 410 feet. The following section was exposed here:

		Ft.	In.
1	**Limestone**, yellowish, gray on fracture, with 4 or 5 shale layers	12	0
2	Shale, dark, limy at bottom	10	0
3	Buff shale and flaggy sandstone	24	0
4	Coal, Washington, with partings	7	2

It crops along the hill road leading south from the mouth of Lynn Camp run, where 7 feet is exposed, coming 32.7 feet above the Washington coal. About one mile and a third N. 20° W. of Adaline on the north side of Fish creek, where the latter has made a long loop to the north and starting back south, this limestone is finely exposed. A section here gives the following:

	Ft.	In.
Massive sandstone	10	0
Sandy shale and sandstone, friable	30	0
Shale	5	0
Coal, slaty	0	2
Fire clay and shale	1	6
Limestone, yellowish, gray on fracture, **Middle Washington**.	7	0
Shale and concealed to creek	25	0

It passes below drainage on Fish creek as it dips down into the basin of the Loudenville (Finney) syncline, but appears to rise when in the vicinity of Kausooth toward the summit of the Washington anticline, and forms the falls, ¾ mile northeast of Kausooth. The limestone at this point may possibly represent the Upper Washington horizon, but the evidence seems to favor the former identification.

In Wetzel county the Middle Washington limestone appears to be confined to the northwestern part along the Ohio river front and along the waters of Proctor creek where it ranges from 5 to 10 feet thick, but is quite silicious, coming 35 feet above the Washington coal. South and southeast from the Proctor creek region this limestone seems to disappear, and was not found at Porters Falls, Reader, Pine Grove or Jacksonburg regions of Fish creek. It was not recognized at all in Tyler county.

The Lower Washington Limestone comes 25 to 30 feet below the Upper Washington limestone and 1 to 5 feet above the Washington coal in the Marshall-Wetzel-Tyler area. Its original description by Prof. Stevenson in Pennsylvania is as follows[15]: "It everywhere accompanies the Washington coal. In Greene county it is commonly found from 6 to 8 feet above the coal, although at one locality on Dunkard creek the interval is 20 feet. It is dark blue with flesh colored layers, weathers bluish white and has a slaty fracture. Its thickness varies from 6 inches on Hunters fork to 3 or 5 feet at most of the other localities in the county. In general appearance it is quite as well marked as the Upper Washington, so that one is frequently enabled to determine the horizon of the Washington coal when everything is concealed except fragments of this limestone." The Lower Washington limestone does not appear to be very persistent in the Marshall-Wetzel-Tyler area and was identified at only 2 or 3 points, having apparently been replaced by massive sandstone and limy shales. In the Burton, Wetzel county, section, page 110, 5 feet of limestone is called for in the detailed log of the Sarah Anderson No. 1 well (W 1), coming 2 feet above the Washington coal. This no doubt represents the Lower Washington, since the Middle Washington, 10 feet thick, is noted 50 feet higher in the well. In Franklin district, Marshall, this limestone occurs 15" thick, coming 5 feet above the Washington coal on Long run of Fish creek, 3 miles S. 10° E. of Graysville. In the section measured down the river hill, 3 miles southwest of New Martinsville, Wetzel county, 2 to 3 inches of impure limestone occurring 4 feet above the Washington coal, was noted. This limestone no doubt represents the Lower Washington In the section measured at Sistersville, page 120, gray limestone boulders apparently in place were found directly over what the writer identified as the Washington coal. If the latter identification is correct, these boulders would represent the Lower Washington limestone.

15. Loc. cit., p. 50.

The Hundred Sandstone.

About 5 feet under the Upper Washington limestone comes a massive sandstone that has been quarried quite a good deal for building purposes along the W. Va. Fork of Fish creek in the extreme eastern edge of Clay district, Wetzel county, about 2 miles west of Hundred from which place the writer has named it the **Hundred Sandstone.** A section nearly opposite the quarry at this point shows as follows:

		Ft.	In.
1	**Slate, black, Jollytown coal**	0	10
2	Limestone, Upper Washington	4	0
3	Shale, limy	5	0
4	**Massive sandstone, Hundred (quarry rock)**	30	0
5	Shale, sandy 2′ to	5	0
6	**Coal, slaty, Hundred**	0	3

In his report on Ores, Building Stones, etc., of the State, Prof. Grimsley identified the sandstone quarried here as being the same massive sandstone that comes between the Dunkard and Jollytown coals and called it the **Dunkard Sandstone.** The above section, recently measured by the writer from actual exposure, establishes beyond doubt that this sandstone belongs **below** and not **above** the Jollytown coal. Since the name "Dunkard" has already been applied to one of the Mahoning sandstones where it once produced petroleum on Dunkard creek, Greene Co., Pa., the writer thought it proper to change the name to that given above. The Hundred sandstone is also well exposed at the east end of Marshall tunnel, a short distance west of the quarry, where it extends from the roof of the tunnel to below railroad grade, and the Upper Washington limestone with the overlying Jollytown coal, crops 5 feet above. At the west end of this tunnel its horizon is represented by only sandy beds. This sandstone crops southeast of Hundred along the public road where 10 to 15 feet is visible. The excavation for the Bank of Hundred building was made in this stratum, although it is not so massive there as at the quarry, 2 miles below. At the east end of Martin tunnel, ½ mile east of Littleton station, it is represented by 22 feet of friable sandstone and sandy shale. It does not appear to be very persistent as a mas-

sive rock and outside of Church and Clay districts, Wetzel county, its horizon is generally represented by red shale and sandy beds.

The Hundred Coal.

At 2 to 5 feet under the Hundred sandstone, a short distance east of the quarry on Fish creek in the eastern edge of Clay district, Wetzel county, occurs a coal that has never been named. The writer has termed it the Hundred coal from the town of that name located one mile and a half to the southeast. The coal is only 3 to 4 inches thick, slaty and apparently of no economic importance. It is exposed on both sides of the creek. This bed was not definitely recognized at any other point in the Marshall-Wetzel-Tyler area.

The Marietta Sandstones.

The interval between the Jollytown and Washington coals is often occupied in its lower part by great sandstone ledges having a total thickness of over 100 feet. These have been named the Marietta sandstones by Dr. I. C. White from their occurrence at Marietta, Ohio, where they have been quarried for building stone and grindstones. In the Marshall-Wetzel-Tyler area there appear to be two distinct ledges which the writer has termed the Upper and Lower Marietta. The relation of these two sandstones to each other and to the Washington "A" and Washington coals is well illustrated by the following section measured down a deep ravine on the Ohio river front in the extreme northern point of Magnolia district, Wetzel county.

		Ft.	In.
1	**Coal. Jollytown**	1	0
2	Limy shale, gray at top, red at bottom	25	0
3	**Massive sandstone, forming cliff, Upper Marietta**	33	0
4	Sandy shale	6	0
5	**Coaly shale and slate, Washington "A" coal**	1	0
6	Shale	15	0
7	Black slate	0	3
8	Limy shale, variegated and red	10	0
9	Limestone, silicious, and limy shale, **Middle Washington**	10	0
10	**Massive sandstone, Lower Marietta**	30	0
11	Shale	2	0
12	Dark shale	0	4
13	Buff limy shale	6	0
14	Coal, slaty 0′ 8″		
15	Coal, good 1′ 7″ **Washington**	2	3

The **Upper Marietta Sandstone** evidently belongs directly over the Washington "A" coal, and forms very steep bluffs and sometimes cliffs wherever it crops above drainage in the three counties. In the McMechen Section, page 131, this stratum is shown to be 20 or more feet in thickness, coming 10 to 20 feet above the Washington "A" coal. It was once quarried along the hill road leading to the east from the north end of McMechen. It was also found in the section 2 miles west of Majorsville where it crops along the hill road leading to the north from Wheeling creek. It crops along the hill road leading south from the mouth of Grave creek Moundsville, where it is 50 feet thick and friable, its base coming 50 feet above the Washington coal. Farther up Grave creek at Rosbys Rock this sandstone occurs cropping along the hill road leading southwest from the town where it is 25 feet thick and quite friable, its base coming 80 to 90 feet above the Washington coal. It also appears in the Lynn Camp section on Fish creek where its base comes 91.7 feet above the Washington coal and 4 feet above the Washington "A" bed.

In Wetzel county this stratum plays an important part in making the steep hillsides along the lower courses of Proctor and Fish creeks. In the section given above for the northern point of Magnolia district, the base of this rock comes 80 feet above the Washington coal. Four miles farther southward and 1 mile east of New Martinsville it is found cropping along the hill road leading up the point at the mouth of Coal fork of Doolin run, coming about 112 feet above the Washington coal. It is 50 feet thick at this point, friable at top and flaggy at bottom, forming a conspicuous bluff around the hill side. It is this same stratum that is quarried on the south side of Fishing creek, at Hastings, 1 mile above Pine Grove, coming 70 feet above the Washington coal and is 55 feet thick. Farther up Fishing creek it is found cropping along the hill road leading northeast towards the summit of Owlshead Knob, ¾ mile west of Jacksonburg, where it is massve and 25 feet thick, coming 90 feet above the Washington coal. In the Arches Fork region, page 108 it appears to be this stratum that comes 667 feet from the top of the section where it was reported 40 feet thick, com-

Plate VII.—Batson Quarry in Hundred Sandstone, Two Miles Below Hundred, Wetzel County.

ing 58 feet above the Washington coal. In the hand leveled section measured down the river hill 3 miles southwest of New Martinsville, page 101, the Upper Marietta sandstone comes 65 feet above the Washington coal, is 20 feet thick and quite massive.

In Tyler county the Upper Marietta sandstone forms steep bluffs along Middle Island creek and its tributaries. In the section measured down the river hill, 1 mile above Sistersville, page 120, the 10 feet of massive sandstone, 35 feet from the top of the section, appears to represent this horizon, coming as it does 82 feet above the Washington coal. It seems to be this stratum that forms the steep bluff over the Washington "A" coal, just above stream level at Pursley, 3 miles southeast of Sistersville, and ⅕ mile up Saltlick run. Passing on southeast to "The Jug" of Middle Island creek, one mile and a half southeast of Middlebourne, we find the Upper Marietta sandstone cropping in a great, vertical cliff 40 feet high, on the north side of the neck of the "Jug," coming 3 feet over the Washington "A" coal, 140 feet above the creek, and 65 to 70 feet above the Washington coal. In the McKim, Tyler county, section it is 38 feet thick, coming 85 feet above the Washington coal. It appears to be the Upper Marietta sandstone that forms the cliff 40 to 50 feet above the level of Little Sancho creek, ½ mile northwest of Owlshead Knob, Meade district, Tyler Co., coming 20 feet above the Washington "A" coal, and having a thickness of 50 to 60 feet.

The **Lower Marietta Sandstone** is also quite massive at many places over the Marshall-Wetzel-Tyler area. A glance at the last section given shows it to be 30 feet thick and very massive, coming in the interval between the Lower Washington limestone and the Washington coal, and 8 feet above the latter bed. On the south side of the creek at Rosbys Rock station this sandstone forms a cliff 20 to 25 feet high, coming 35 to 40 feet above the creek, and immediately over the Washington coal. This sandstone crops along the road leading east from the mouth of Sims run, ½ mile north of Clarington station where it is 15 feet thick, coming 10 feet above the Washington coal. In the section measured by hand level down the river hill, 3 miles southwest

of New Martinsville, this stratum is 25 feet thick, coming 9.2 feet over the Washington coal. It has been quarried along the street car line a short distance east of this point for building purposes. On Fishing creek in the Pine Grove section this sandstone is 30 to 35 feet thick, coming 2 to 5 feet above the Washington coal. There is an old quarry in this rock on Shenango run, 1 mile northwest of Pine Grove, where it is 25 to 30 feet thick and very massive, coming 20 to 25 feet above the Washington coal. It was noted at a few points in Tyler county. In the McKim, Tyler county section, it is 15 feet thick, coming 20 feet above the Washington coal.

Both the Upper and Lower Marietta sandstones should furnish quite a fine quality of good building stone, and they can also frequently be used for grindstones.

The Washington "A" Coal.

At 70 to 80 feet above the Washington coal in the Marshall-Wetzel-Tyler area occurs a fairly persistent coal bed that has been designated the **Washington "A" coal.** Dr. I. C. White has the following to say concerning this bed[16]: "At 70 to 80 feet above the Washington coal, there occurs a bed of impure coal and coaly shale which is often present in the section along Dunkard creek. Sometimes the entire bed is 4 to 5 feet thick, but little of it is ever merchantable coal, being seldom more than bituminous slate. It is well exposed in the hills about Blacksville and Brownsville, and there contains many bivalve crustaceans."

An examination of the Steelton, Wetzel Co., section on page 156, will show that the horizon of this coal at this point comes 73½ feet above the Washington coal, 25 feet above the Middle Washington limestone, and 6 feet under what the writer has designated as the Upper Marietta sandstone.

In Marshall county this bed was noted at many points. In the McMechen section its horizon is represented by 5 inches of black slate, coming 5 feet above the Middle Washington limestone and 47 feet above the Washington coal. Along Wheeling

16 Bulletin No. 65, p. 35, U. S. Geol. Survey.

creek in the northern part of the county this coal crops in the road leading eastward up the point from the mouth of Grandstaff run where it is represented by slaty blossom and fire clay, coming 84 feet above the Washington bed. It does not appear to be represented in the section measured at Rosbys Rock on Grave creek. In the section measured at Powhatan station this coal is 10 inches thick, coming 85 feet above the Washington bed. In the section measured east up the hill road at Franklin station, this coal was not observed although the horizon was exposed. About 2 miles farther southwestward, one foot of fire clay crops along the river hill road leading east from the mouth of Sims run, coming 55 feet above the Washington coal and 17 feet below the base of a massive sandstone (Upper Marietta). This fire clay possibly represents the horizon of the Washington "A" coal.

In Wetzel county this coal crops along the hill road leading northeast from Proctor creek, 1 mile below Marion, where it is represented by 12 inches of fire clay, coming 85 feet above the Washington coal. In the section given for the northern point of Magnolia district, Wetzel county, showing the relation of the Upper and Lower Marietta sandstones, this coal is represented by 12 inches of **coaly shale** and **slate,** coming 73½ feet above the Washington coal.

The Washington "A" coal appears to be more persistent in Tyler county than in either Marshall or Wetzel. About 3 miles southeast of Sistersville on Saltlick run of Pursley creek, ⅓ mile southwest of Pursley P. O., a coal that appears to represent the Washington "A" crops on the south bank of the run where the following section is exposed:

		Ft.	In.
1	Massive, sandstone, **Upper Marietta**	25	0
2	Shale, red and gray 10′ to	15	0
3	Black shale	0	2
4	**Coal, Washington "A" good 10″ to**	1	1
5	Gray shale to creek	3	0

Its tidal elevation here is about 800 feet, coming 1675 feet above the top of the Keener Sand as shown by the logs of the Aaron Scannahorn No. 1 well (T 32) and G. L. Meredith No. 1 (T 33A). The Washington coal should come about 1600 to

1610 feet above the Keener Sand as shown by the log of the J. M. Ice No. 1 well (T 1) on Willow fork of Point Pleasant creek, 4 miles due northeast, where the Washington coal crops flush with the top of the hole. This latter interval is almost the same (1600 to 1610 feet) in the 2 sections given at Sistersville on preceding pages of this report, so that the coal in the above section, coming 1675 feet above the Keener Sand, must represent the **Washington "A" bed.** This coal has been mined by stripping on the tributaries of Pursley creek. One of these points is located about ¾ mile S. 60° W. of Luzon where the coal has an elevation of 770′ A. T. Another is located near the axis of the Shiloh syncline, ½ mile northeast of Luzon, where the coal has dipped down to 760′ A. T., coming 470 feet above the Pittsburg coal and 1669 feet above the Keener or top portion of the Big Injun Sand as shown by the log of the A. Heinzman No. 1 well (T 34) at this point, the coal cropping flush with the top of the hole. The coal had been mined out of the bed of the run, and Mr. Ira Wilcox, a farmer living near here, says the coal is 18 inches thick without any partings. Passing on southeast to the "Jug" of Middle Island creek, 2 miles southeast of Middlbourne, this coal occurs cropping on the south side of the neck of the "Jug" where it is 8 inches thick, coming 3 feet below the great cliff rock on the north side, 53 feet (hand level measurement) above the Washington coal, and about 805 fet above tide. Its crop is also exposed 2 miles southward along the road leading up Jug run, but only its blossom is visible here.

On Muddy creek of Middle Island, 5 miles S. 80° E. of Middlebourne, occurs the blossom of a coal at an elevation of 913′ A. T., coming at the base of a massive sandstone, 90 to 100 feet above the Washington bed, cropping below, and 580 feet above the Pittsburg coal as shown by the log of Isaiah Baker No. 3 well (T 122). This blossom appears to represent the Washington "A" coal and shows, as it should, a slightly greater interval above the Washington bed than at the neck of the "Jug," 3⅓ miles westward. In the section given for Big run of Indian creek, page 114, one mile and a half southeast of the Muddy creek region, 3 inches of dark bituminous shale occurs 65 feet above the Washington coal, and possibly represents the Wash-

ington "A". On the extreme head of Elk Fork of Pt. Pleasant creek, a short distance southeast of the Eliza Lemasters No. 1 well (T 125) occurs 2 inches of coal that appears to be this bed, coming about 560 to 570 feet above the Pittsburg coal and at an elevation of about 905' A. T. In the Meade district, Tyler, it appears to be this bed that crops along the road, ½ mile northwest of the summit of "Owlshead" knob, on Little Sancho creek. In the McKim section, page 118, its horizon is probably represented by the 4 feet of **green slate** (fire clay coming at the base of a sandstone (Upper Marietta), 81 feet above the Washington coal and 225 feet above the Pittsburg bed. It appears to be this coal that crops along the public road on the north side of Little Sancho creek, ¾ mile east of Bert, P. O., where it is 10 to 12 inches thick, coming 1700 feet above the Big Injun sand and 820 feet above tide, or 35 feet lower than at the point ½ mile northwest of Owlshead Knob, showing the dip of the rocks on the eastern flank of the Wick anticline. The blossom of a coal crops along the road near the head of Right Buffalo fork, 2.3 miles southwest of Pursley, coming about 815' A. T., that appears to represent the Washington "A". It is about 60 to 75 feet under another double-bedded coal 6¾ inches thick that possibly represents the Jollytown bed, or the same coal that was mined near the summit of the hill at Pursley.

The Washington Coal.

The Washington coal is the most persistent as well as the most important bed of the Dunkard series in the Marshall-Wetzel-Tyler area. Dr. I. C. White[17] has the following to say concerning this coal:

"This bed which is the only one of the Dunkard series that is workable over a wide area was first described by the writer, and named the Brownsville coal from its occurrence at the village of that name in Monongalia county, West Virginia. Subsequently, however, the same coal was found in greater development at Washington, Pennsylvania, and it was designated from that locality by Prof. Stevenson.

17* Bulletin 65, p. 37, U. S. Geological Survey.

"It is always a multiple bed, being separated into two or three layers by divisions of slate. Occasionally these divisioins are numerous and the entire thickness of the bed is 8 to 10 feet, but in all cases the only pure or merchantable coal is the bottom portion, which seldom exceeds 2½ to 3 feet. The upper part of the bed is nearly always very impure, since it contains so much ash and slate as to constitute it a mere bed of richly bituminous shale.

"The following section of this coal, taken near Farmington, Marion county, West Virginia, well illustrates the structure of this bed when it is thick.

		Ft.	In.		
1	Coal	0	6		
2	Shale	0	3		
3	Coal and shale	0	8		
4	Coal	1	0		
5	Shale	0	4		
6	Coal	0	5		
7	Shale	0	3	6	1
8	Coal	1	0		
9	Shale	0	4		
10	Coal	1	1		
11	Shale	0	3		
12	Coal, fair	2	0		
13	Slate	0	2	4	8
14	Coal, good	2	6		
	Total			10	9

"Here the upper or roof portion of the coal, although 6 feet thick, is entirely worthless, and the only really good coal in the bed is the 2½ feet at the bottom."

In the Marshall-Wetzel-Tyler area the Washington coal corresponds to the sections above, in that the top portion is generally slaty coal and the 18 inches to 2 feet of the bottom the purest portion of the bed. The general distribution of this coal over the 3 counties will be taken up under the chapter on their coal resources, but a few sections will now be given to show its structure, general character, and position with reference to other strata directly above and below the bed.

On the south bank of Wheeling creek, one mile and a half west of Viola, in northern Marshall county, the writer measured the following section:

					Ft.	In.
1	Limestone, gray, Middle Washington				10	0
2	Concealed and shale				35	0
3	Coal, slaty	0′	8″	Washington	4	11
4	Sandy shale	3′	0″			
5	Coal, better but slaty	1′	3″			

The 3 foot parting between the top and bottom portions of the bed is unusual, since as a rule it is generally less than 6 inches, sometimes thinning entirely away. At this point it comes about 110 to 115 feet above the base of the Dunkard series, or top of the Waynesburg coal.

Another section of this bed in the southern part of the county on Fish creek, where exposed along the public road leading south up the hill from the mouth of Lynn Camp run shows the following:

	Ft.	In.
Slate, black	0	4
Coal	1	0
Slate, black	2	0
Coal	0	2
Slate, black	0	2
Coal, good	1	1
Total	4	9

Its elevation here is about 775′ A. T., coming 32.8 feet below the Middle Washington limestone, 60.6 feet above the Waynesburg "A" coal, 415 feet above the Pittsburg bed, and 1540 feet above the top of the Big Injun Sand as shown by the log of the Isaac Crow No. 2 well (M 49), near the mouth of Upper Bowman run.

In Grant district, Wetzel, where the Littleton anticline crosses the North fork of Fishing creek at Lowman P. O. (Kingtown), a coal crops at the forks of the road at an elevation of 810′ A. T. The tidal elevation of the Pittsburg coal at this point as shown by the Roland Barr No. 1610 well (W 138) is about 327′ A. T., or 483 feet lower in the measures. The coal cropping here appears to represent the Washington bed. A section of the seam exhibits the following structure:

		Ft.	In.
1	Coal, shaly	0	8
2	Shale, gray	0	8
3	Coal	0	0 ½
4	Gray, sandy shale	0	4
5	Coal, shaly	0	5
6	Slate, black	0	2
	Total	2	3½

This coal is exposed along a deep ravine on the Ohio river front in the extreme northern point of Magnolia district, Wetzel county, about midway between Proctor and Steelton, where it exhibits the following structure:

			Ft.	In.
1	Coal, slaty	0′ 8″		
2	Coal, good	1′ 7″	2	3

At this point it comes about 75 feet below the Washington "A" coal, 35 to 40 feet below the Middle Washington limestone, and 60 feet above the Waynesburg "A" bed.

On Proctor creek, 1 mile below Marion, and also at the mouth of Coal fork of Doolin run it comes 1548 and 1557 feet above the top of the Big Injun Sand, 405 and 437 feet above the Pittsburg coal as shown by the logs of the J. W. O'Neil No. 1 well (W 285) and the Samuel Martin No. 1 well (W 302) respectively. Passing up Fishing creek from the Ohio river region, it is found cropping opposite the mouth of Richwood run, ¼ mile southeast of Jacksonburg, coming 495 feet above the Pittsburg bed and 1768 feet above the top of the Big Injun Sand as shown by the Owlshead Knob section on page 107. These intervals show a rapid thickening of the measure southeast from the Ohio river. The multiple bedded nature of the Washington coal is well illustrated by the following section measured at this point:

		Ft.	In.
1	Coal, slaty	1	0
2	Slate, black	0	3
3	Coal	2	4
4	Slate, black	0	4
5	Coal, streaks of slate	1	1
6	Slate, black	0	8
7	Shale, gray	1	0
8	Coal, bony	0	6
9	Coal, good	0	6
	Total	7	8

Here it comes 70 feet above the Waynesburg "A" bed and 135 feet above the base of the Dunkard series, or roof of the Waynesburg coal.

In Greene district, Wetzel, the crop of this coal is well exposed at an old opening on the west side of Piney fork 2 miles above its mouth at an elevation of about 735 to 740 feet A. T. where the following structure is exhibited:

		Ft.	In.
1	Coal, slaty	1	0
2	Slate, black	0	2
3	Coal, better	1	0
4	Slate, dark	0	2
5	Coal, good	1	4
	Total	3	8

At this place it comes 475 to 480 feet above the Pittsburg bed.

In eastern Tyler county it crops on the north side of the road leading up Indian creek, a short distance (100 to 200 yards) east of Braden Station (Lima P. O.) at an elevation of about 800′ above tide, coming about 490 feet above the Pittsburg bed. The following section is exposed here:

				Ft.	In.
1	Massive sandstone, **Lower Marietta**			30	0
2	Coal, slaty..	0′	6″		
3	Slate, black.	0′	9″	2	5
4	Coal, good..	1′	2″		

Passing on south to the southern point of Tyler county to a point at Camp P. O. near where the axis of the Big Moses anticline crosses the Tyler-Doddridge line, this coal is found cropping at an elevation of 886 feet A. T., coming 463 feet above the Pittsburg coal as shown by the log of the W. W. Pratt No. 1 well (T 158) close by. It has the following structure here:

		Ft.	In.
1	Coal, medium	1	5
2	Slate, gray and hard 2″ to	0	6
3	Coal, good	1	3
	Total	3	2

The bottom portion of this bed has been mined for local domestic fuel at several points along Middle Island creek in this county. Passing to the Ohio river front it is found exposed along the turnpike leading up the hill southeast from Sistersville where it is 21 inches thick, coming at an elevation of 850′ A. T., 170 feet above the Uniontown coal, 403 feet above the Pittsburg bed, and 1587 feet above the Keener Sand, the top portion of the Pocono.

The Washington Sandstone.

Very frequently the Washington coal rests directly upon a flaggy sandstone as at Rosbys Rock, Marshall county, where the following section is exposed on the south side of Grave creek at this point:

		Ft.	In.
1	**Coal, Washington**	2	0
2	Fire clay	1	0
3	Sandstone, flaggy and sandy shale with fossil plants, **Washington Sandstone**	11	0
4	**Coal, Little Washington 9″ to**	1	0

This stratum is not conspicuously developed at any other point in the area. It was called the Washington Sandstone by Prof. John J. Stevenson.

The Little Washington Coal.

Immediately under the Washington coal, 10 to 20 feet, there sometimes occurs another thin bed that has been designated the **Little Washington coal** by Prof. Stevenson from the Washington county, Pa., region. The above section shows its position with reference to the Washington coal. It does not appear to be a very persistent horizon in the Marshall-Wetzel-Tyler area.

The Mannington Sandstone.

At 15 to 20 feet below the Washington coal there often occurs a massive sandstone that is very persistent in Wetzel and Tyler counties, sometimes attaining a thickness of 40 to 50

feet. This stratum has recently been named by Prof. G. P. Grimsley[18] the **Mannington sandstone** from its outcrop near the town of that name in Marion county, W. Va., where it has been quarried, supplying stone for the city. His original description is as follows:

"At the west edge of the city of Mannington, J. D. Charlton has opened a small quarry which has supplied stone for the city for several years. The floor of this quarry is 50 feet above creek level in the city. Oil wells at this lower level strike the Pittsburg coal at a depth of 400 feet, which gives an interval of 450 feet between this coal and the sandstone at the quarry.

"— The stone has a greenish, gray color and is finely laminated along planes formed of black mica. The quartz grains are very small giving the rock a close texture and white and black mica specks occur all through the stone, though especially abundant along the foliation planes.

"Quarry. The face of the quarry runs N. 40° W. and is 75 feet long and is worked back 30 feet. Below the sandstone is a heavy shale formation reaching down to the road 20 or 30 feet. A section of the quarry shows:

	Feet.
Shales	4
Buff, shaly sandstone	15
Blue and buff sandstone	6
Shales.	

"The joint planes run N. 60° to 70° W. and N. 40° W. A few curved joint planes were observed starting at an angle of N. 12° W. and changing to N. 30° W."

In Webster district, Marshall county, this stratum was noted in the detailed log of the J. T. Cox No. 1 well (M 24), on the head of Wolf run, ¾ mile northeast of Beelers Station where the following partial section is given:

	Ft.	In.
Limestone, hard, **Middle Washington**	10	0
Red rock	5	0
Slate	15	0
Coal, Washington	2	0
Slate	15	0

18. Vol. IV, W. Va. Geol. Survey, page 440.

	Ft.	In.
Bluff sand (little water), Mannington	30	0
Interval	103	0
Coal, Waynesburg	6	0
Interval	279	0
Coal, Pittsburg	5	0

This section illustrates in an admirable manner the true position of the Mannington sandstone with reference to the Washington and Waynesburg coals. In the Lynn Camp section it is shown to come between the Washington and Waynesburg "A" coals. In most of the Marshall county sections its horizon is generally represented by friable sandstone and sandy beds, except on the Ohio river front south from Powhatan station. In the section measured at the latter point it is represented by 25 feet of massive sandstone with shale in middle, coming 15 feet below the blossom of the Washington coal and 70 feet above the Waynesburg coal.

It is the great cliff rock outcropping along Doolin run, east from New Martinsville, Magnolia district, Wetzel county, where it is 30 to 40 feet thick, coming 15 feet below the Washington coal, and 5 to 10 feet above the Waynesburg "A" bed. Passing up Fish creek from the New Martinsville region to Pine Grove, Wetzel county, this stratum is found about the same interval below the Washington coal, and is quite massive. In the M. V. Anderson core test well (W 177), 1 mile southeast of Jacksonburg, its horizon is represented by sandy shales and thin sandstones in the bottom portion. In the core test well (W 150) at Mobley, Wetzel county, it is represented by 23 feet of sandy shale, coming 9 feet below the Washington coal.

In the section measured down the river hill, 3 miles southwest from New Martinsville, it is 50 feet thick and somewhat friable, coming 12.4 feet below the Washington coal.

The Mannington sandstone is quite a prominent cliff rock in many parts of Tyler county, West Virginia. It crops along the hill road leading south from Paden city, where it is quite massive, having a thickness of 30 feet. Southwest from this point along the river hill it rises rapidly on the slope of the Sistersville anticline and in the section measured 1 mile northeast of Sistersville is found near the top or summit of the hill,

where it is represented by 14 feet of sandstone, coming 25 feet below the Washington coal, and 15 feet above the Waynesburg "A" bed.

Passing eastward from the river to Kidwell at the mouth of Elk fork of Pt. Pleasant creek, this stratum occurs along the road on the north side of the rounded knob just west from the village, where it forms a cliff, coming directly over the Waynesburg "A" coal, and 10 to 20 feet below the Washington bed. From this point on down Pt. Pleasant creek to its mouth, ½ mile north of Middlebourne, it forms cliffs and conspicuous bluffs. A section measured on the east side of Pt. Pleasant creek along the road, ⅓ mile above its mouth, gave the following exposures:

		Ft.	In.
1	**Massive sandstone, Mannington**	25	0
2	**Coal, slaty Waynesburg "A", 0" to,**	0	3
3	Shale, gray	3	0
4	Shale, reddish	5	0
5	Sandstone, to road	3	0
6	Concealed to creek level	12	0

The Washington coal crops about 50 feet above the Waynesburg "A" here, or 25 feet above the top of the sandstone. Passing up Middle Island creek from Middlebourne to where its horizon is exposed on the south side of the neck of the "Jug", it is here represented by sandy beds and thin sandstones. On up Middle Island, however, it is found quite massive, cropping just above run level on Muddy creek at Frew P. O. Its outcrop is also exposed at stream level at the mouth of Blue run at Blue P. O. Passing up Indian creek to Booher, 1 mile northeast of Big Moses, near where the axis of the Big Moses anticline crosses the stream, the following exposure occurs on the south side of the creek:

		Ft.	In.
1	**Coal, Washington** (old openings) 2 to	3	0
2	Concealed and shale	10	0
3	Sandstone, massive, forming cliff 40 to	50	0
4	Concealed to creek	35	0

Two miles N. 30° W. of this point it was noted in the log of the W. W. Myers No. 1 well (T 137) on Big run of Indian creek, where it is 50 feet thick, coming 20 feet below the Wash-

ington coal, approximately 60 feet above the base of the Dunkard series, and 390 feet above the Pittsburg coal. It forms prominent bluffs along the hillsides of McElroy creek. Passing on up Middle Island creek from the mouth of McElroy to a point one mile and a quarter northwest of Deep Valley P. O. and ¾ mile below the mouth of Camp Mistake run, this stratum forms a cliff 40 feet high on the north side of Middle Island creek, where it has been quarried somewhat for building purposes, coming about 50 feet above creek level, or 760 feet above tide. Its outcrop is well exposed along Little Camp Mistake run west from Wilbur where it is 30 to 40 feet thick. In the detailed log of the Moses Johnson No. 1 well (T 229) used by the writer in making up the McKim section, page 118, this sandstone was found 325 feet from the top of the hole where it has become a great micaceous rock 85 feet in thickness and it is quite likely that this stratum has coalesced with the Waynesburg below, eroding away completely all signs of the Waynesburg "A" coal. The log of this well was kept with great care by the drilling crew, and a set of the samples was kindly presented the State Survey by Mr. W. H. Aspinwall of the Carter Oil Company which owns the well.

The Mannington sandstone forms the bed of Sancho creek at the mouth of Foster run, 3¼ miles due south of Middlebourne, making a cliff 20 to 25 feet higher than stream level. The Washington coal crop is exposed 10 to 15 feet above the top of the sandstone.

What appears to be the outcrop of this sandstone is exposed along the turnpike leading southeast up the hill at Sistersville where 15 feet of the bottom portion is visible, coming 6 feet over the Waynesburg "A" coal, cropping at the watering trough on the north edge of the road, the latter bed having heretofore been identified as the Washington coal, but since it comes only 125 feet above the Uniontown bed as shown by the Sistersville Turnpike section on page 121, it cannot be the Washington.

The Waynesburg "B" Coal.

At 40 to 50 feet below the Washington coal in Monongalia Co., W. Va., and Greene and Washington counties, Pa., there

often occurs a coal bed that has been designated the Waynesburg "B" coal, representing the second bituminous horizon above the Waynesburg coal proper. On the south side of Wheeling creek, one mile and a half N. 80° W. of Viola P. O., what appears to be this coal crops 25 feet below the Washington bed, where it is 8 inches thick, coming directly over 4 feet of limestone. In the section measured on the opposite side of the Ohio river at New Martinsville, page 158, the writer has identified with this seam the 2 feet of coal coming 72 feet above another bed once mined there about 50 feet above low water. It may be possible that the latter seam may represent the Uniontown coal, and if so, the one designated in this section as the Waynesburg "A", 42 feet higher, would represent the Waynesburg coal proper. An examination of the log of the M. V. Anderson core test well (W 177), 1 mile southeast of Jacksonburg, Wetzel county, would appear to indicate that the 6 feet of fire clay and streaks of lime, coming 23 feet below the Washington coal, 40 feet above the Waynesburg "A" bed and 104 feet above the Waynesburg coal, represents the horizon of the Waynesburg "B" seam. In the core test well (W 150) drilled at Mobley, Grant district, Wetzel county, the horizon of the Waynesburg "B" coal appears to be represented by 3 feet 7 inches of fire clay, coming 32 feet below the Washington coal, 30 feet above the Waynesburg "A" bed, 45 feet above the top of the Waynesburg sandstone, and 94 feet above the Waynesburg coal. It does not appear to be persistent in the Marshall-Wetzel-Tyler area and in Wetzel and Tyler counties seems to have been cut away entirely by the great Mannington sandstone, the latter often having a thickness of 40 to 50 feet and extending down to 60 feet below the Washington coal.

The Waynesburg "A" Coal.

The Waynesburg "A" coal represents the first coal above the Waynesburg bed, coming 80 to 90 feet above the latter according to Dr. I. C. White, concerning which he has the following to say in Vol. II., page 116 of the Survey reports:

"The only coal in this group[19] which is ever of any economic

19* Referring to the Dunkard group or series.

importance is the Waynesburg "A" bed, 80 to 90 feet below the Washington coal and the same interval above the Waynesburg, or base of the Dunkard series. This bed is quite generally present 10 to 15 feet above the Waynesburg sandstone, through Monongalia, Marion, Harrison, Doddridge, and Tyler counties and occasionally attains a thickness of 3½ feet. The coal contains much ash and other impurities, however, and makes only an indifferent fuel. It has been mined to a small extent in western Harrison and eastern Doddridge for local domestic use. Its presence is generally marked by a line of springs which come out of the ground on top of the impermeable clays and shales just below, and which, easily disintegrating, give origin to very bad roads with deep sticky mudholes along this line of outcrop."

In the Marshall-Wetzel-Tyler area this bed comes second in economic importance of the coals of the Dunkard series. Its true position with reference to other strata is well shown in the core test well (W 177) 1 mile southeast of Jacksonburg, Wetzel county, where it is represented by only 4 inches of coal, coming 70 feet below the Washington bed, 40 feet below the Waynesburg "B" horizon, 16 feet above the top of the great Waynesburg sandstone (40′ thick), 62 feet above the Waynesburg coal, and 420 feet above the Pittsburg bed. In the core test well at Mobley, Wetzel county, its horizon is represented by 3 inches of bituminous material, coming 75 feet below the Washington coal, 31 feet below the Waynesburg "B" horizon, 14 feet above the top of the Waynesburg sandstone (49′ thick), 64 feet above the Waynesburg coal, and 418 feet above the Pittsburg bed. The core test at Mobley (W 150) is almost exactly 4¾ miles N. 60° E. from the test well (W 177), near Jacksonburg, and the above data shows that the intervals agree remarkably well. From the two records it is evident that the horizon of the Waynesburg "A" coal belongs near the midway point (possibly 5 to 10 feet below) of the interval between the Washington and Waynesburg coals.

In Sandhill district, Marshall county, its horizon is exposed along the road leading north up the east side of Worton run from Majorsville, where it is represented by 10 inches of bitu-

minous shale, coming 60 feet below the Washington coal and 57 feet above the Waynesburg bed. At this point it comes directly over 5 feet of silicious limestone and limy shale. In the Middle Grave creek section its horizon is represented by a slaty blossom. In the section made at Moundsville, its horizon belongs in the 30 feet of concealed interval, 43 feet below the Washington coal. Passing on down the Ohio river to the mouth of Hog run, ⅓ mile northeast of Captina P. O. (Powhatan Station), this coal occurs cropping along the road leading up the hill to the northeast on the north side of the latter stream, where its blossom is quite heavy, coming 67 feet below the Washington coal. Its outcrop is well exposed along the hill road leading east from Franklin station, Marshall county, where it is 2½ feet thick and quite pure, coming 52.5 feet below the Washington coal, 37.3 feet above the Waynesburg bed, and 322 feet above the Pittsburg vein, the latter interval being almost 100 feet less than at Mobley, Wetzel county.

It appears to be this coal that crops along the hill road leading east from the mouth of Sims run, ½ mile northeast of Clarington station, where it is 3½ feet thick, coming only 30 feet above the Waynesburg bed, and 80 feet below the Washington coal. About 3½ miles N. 80° E. of the latter point its crop is exposed near the bed of Long run, a stream putting into Fish creek from the south 1 mile up from the latter's mouth. Its elevation here is about 810′ A. T. The following section is exposed at this point:

			Ft.	In.
1	Sandstone		10	0
2	Limy shale		6	0
3	Coal, slaty	0′ 2″		
4	Slate, gray	0′ 8″		
5	Coal	0′ 1½″		
6	Slate, gray	0′ 10″		
7	Coal, slaty	0′ 2″		
	Waynesburg "A"		1	11½
8	Limestone, dark and hard		0	2
9	Slate, gray			

This coal has been mined for local domestic use at several points along Fish creek in Marshall county between Graysville and Meighen P. O. at the mouth of Lower Bowman run. Its horizon was concealed at the point where the Graysville section was measured.

Abouth 3 miles southeast of this village the outcrop of this coal is exposed in a ravine opposite the mouth of Whetstone run, where the writer measured the following section:

		Ft.	In.
1	Coal	0	3
2	Shale, variegated	1	9
3	Dark shale	0	6
4	Coal	1	0
5	Slate, black	0	1
6	Coal	0	11
	Total	4	6

This coal has recently been opened for local domestic fuel on the land of Wm. J. Hall, on the north side of Fish creek, 1 mile and a third N. 80° W. of Meighen P. O., where the writer measured the following section:

		Ft.	In.
1	Slate, black		
2	Coal	1	6½
3	Slate, black 1-8″ to	0	0¼
4	Coal	0	4
	Total	1	10¾

A sample for analysis was collected at this mine the composition of which was reported by Mr. Krak, Asst. Chemist of the Survey, as follows:

Proximate Analysis.	Per cent.	Ultimate Analysis.	Per cent.
Moisture	1.01	Carbon	62.67
Volatile matter	35.25	Hydrogen	5.74
Fixed carbon	46.03	Oxygen	10.15
Ash	17.71	Nitrogen	0.85
		Sulphur	2.88
		Ash	17.71
Total	100.00	Total	100.00

	Per cent.
Sulphur	2.88
Phosphorus	0.036

Calorific value:

Calorimeter B. T. U.	
Calculated B. T. U.	12,004

$$\frac{\text{Carbon}}{\text{Oxygen} + \text{Ash}} = \frac{62.67}{10.15 + 17.71} = 2.25$$

About one mile and three-fourths S. 15° E. of the Hall opening this coal crops near the level of Whetstone run, flush with the top of the W. S. Howard No. 1 well (M 97) at an elevation of 750′ A. T. The following section at this point, made from exposures and the log of the Howard well shows the position of this bed in southern Marshall:

		Ft.	In.
1	Sandstone, friable	8	0
2	Shale, dark	5	0
3	**Coal, good, Waynesburg "A"**	2	5
4	Shale, black	1	0
5	Limestone, hard to top of hole	0	6
6	Unrecorded	60	0
7	**Coal, Waynesburg**	3	0
8	Unrecorded	201	0
9	**Coal, Sewickley**	4	0
10	Unrecorded	85	0
11	**Coal, Pittsburg**	6	0
12	Unrecorded	1211	0
13	Big Injun sand	283	0

The limestone, 1 foot under the Waynesburg "A" coal, appears to accompany this bed wherever exposed in Marshall county.

Passing on up Fish creek from the Hall opening to Meighen P. O. at the mouth of Lower Bowman, we find this coal was once mined by a shaft 6 feet in depth where its elevation is about 685′ A. T. and was reported 18 inches thick and of fair quality. It has been mined by stripping out of the bed of Middle Bowman run near its mouth on the north side of the road leading up Fish creek, on the land of T. J. West where the following section is exposed:

		Ft.	In.
1	Coal	0	1
2	Slate, gray	0	1 ½
3	Coal	0	0 ½
4	Slate with streaks of coal	0	8
5	Shale, gray	1	4
6	Coal, good	1	6
	Total	3	9

At this point it comes about 60 feet below the Washington coal cropping in the hill above, and 100 feet below the Middle Washington limestone (12 feet thick). Mr. West uses this coal

for domestic fuel and reports it almost as good as the "Moundsville" (Pittsburg) coal, in that it burns up better into ashes without clinkering.

Farther up Fish creek it outcrops at the foot of the hill road, leading south, at the mouth of Lynn Camp run. A section there shows as follows:

				Feet
1	**Coal, Washington,** with partings			4.9
2	Concealed			38.2
3	Sandstone, friable and shale			22.4
4	Coal	0.1		
5	Shale, dark, fossil plants	0.7		
6	Coal	0.1		
7	Shale, dark, soft	0.5	**Waynesburg "A"**	4.6
8	Shale, gray	0.7		
9	Slate, black	0.5		
10	Coal, slaty	2.0		
11	Fire clay and shale			2.6
12	Limestone, visible			1.0
13	Concealed to creek level			12.0

It comes about 60 feet above the Waynesburg coal as shown by oil well records in this vicinity. In the Joshua Yoho No. 1 well (M 83), located on the hillside of Valley run of Fish creek, 1 mile due south of Adaline P. O., this coal was struck at a depth of 510 feet and reported 5 feet thick, coming 345 feet above the Pittsburg bed.

Along the Ohio river front of Wetzel county the outcrop of this coal is well exposed in a deep ravine at the extreme northern point of Magnolia district where the following section was measured:

			Ft.	In.
Coal, slaty	0′ 8″			
Coal, good	1′ 7″	**Washington**	2	3
Gray limy shale			15	0
Sandstone, **Mannington** and shale			42	0
Slate with streaks of coal	0′ 2″			
Shale gray	1′ 0″			
Coal, slaty	0′ 10″	**Waynesburg "A"**	2	8
Coal, good	0′ 8″			

The Waynesburg "A" bed comes 10 feet above the top of a massive sandstone (Waynesburg) 35 feet thick, forming a cliff and about 50 feet above the horizon of the Waynesburg coal.

This coal crops 17 feet above drainage at the forks of the road on the Left fork of Proctor creek in Wetzel county, where the following section is exposed:

		Ft.	In.
1	Sandstone and shale	25	0
2	Shale, dark	3	0
3	Coal	1	0
4	Black slate and concealed	10	0
5	Massive sandstone to creek level	7	0

Its elevation here is 760′ A. T., coming 360 and 1500 feet above the top of the Pittsburg coal and Big Injun Sand respectively, and 70 feet below the Washington coal cropping in the hill road near the schoolhouse.

On main Proctor creek and about 1 mile above the mouth of Left fork, a coal crops in the bed of the stream that appears to represent the Waynesburg "A" bed. Its elevation there is about 700′ A. T. The following is a section at this point:

		Ft.	In.
1	Massive sandstone forming cliff, Mannington	30	0
2	Slate, black and flaggy	0	3
3	Limestone, gray and hard	2	0
4	Shale, limy	7	0
5	Shale, dark	2	0
6	Coal, Waynesburg "A"	0	3
7	Fire clay to creek	0	3

It comes about 60 feet below the Washington coal at this point. It may be that the 3 inches of black slate above the limestone represents the Waynesburg "A" bed, since a limestone is generally found coming directly under this coal in Marshall county, and if so, the 3 inches of coal is only a local deposit.

In the core test well put down on the Ed Wagner farm by J. M. Hall et al., near the head of Coal fork of Doolin run, 2¼ miles N. 72½° E of New Martinsville railroad station, this coal was struck at a depth of 278 feet, having a thickness of 8 inches. and coming 62½ feet below the Washington coal, 56 feet above the Waynesburg horizon, and 146 feet above the Uniontown bed. Its elevation here is about 605′ A. T. Its outcrop is exposed on the north side of the road leading up Doolin run, a short distance above the mouth of Coal fork, where it is 2½

inches thick, coming at the base of the Mannington sandstone, the latter forming a cliff at this point 30 feet high. The dip of the rocks eastward from the Ohio river in Wetzel county, soon carries this bed below drainage, being exposed only in a narrow strip along the western edge of Proctor and Magnolia districts.

In Tyler county the crop of the Waynesburg "A" coal is exposed over a wide area and is often taken for the Washington bed, 50 to 60 feet higher in the measures. Near the Ohio river front it appears to be this coal that was once mined on the east side of Owl run, 2½ miles northeast of Sistersville, at an elevation of about 775′ A. T. where the following section is exposed:

		Ft.	In.
1	Massive sandstone, visible	4	0
2	Sandy shale	3	0
3	Gray shale	3	0
4	Coal	2	0
5	Concealed.		

The mine had been abandoned and the full thickness of coal was not obtained. According to the log of the A. C. McCallum No. 1 well (T 7) near by it comes 1555 feet above the top of the Big Injun sand, while the interval for the Washington coal above this sand should be near 1600 to 1610 feet for this region. A coal crops along the turnpike leading southeast up the hill from Sistersville on the north edge of the road at a watering trough that has heretofore been identified as the Washington coal,[20] but appears to represent the Waynesburg "A" bed coming as it does only 1542 feet above the top of the Keener sand and 358 feet above the Pittsburg coal as shown by the logs of the J. B. McCoy No. 15 well (T 18A) and J. T. Leasure No. 3 well (T 14A). Its section here is as follows:

		Ft.	In.
1	Coal, slaty	1	8
2	Slate with streaks of coal	0	6
3	Coal	1	8
	Total	3	10

20. Vol. II, page 114, W. Va. Geol. Survey.

It comes here 40 to 45 feet below another bed, 21 inches of which is visible, that represents the Washington coal.

On the head of Narrows run, 2 miles southwest of Sistersville, a coal that appears to represent the Waynesburg "A" seam crops at the bed of the stream where the writer made the following section.

				Ft	In.
1	Coal, slaty	1′	8″	3	3 ½
2	Slate, black	0′	1½″		
3	Coal	1′	6″		
4	Concealed.				

Its elevation here is about 815′ A. T., coming 1557 feet above the top of the Big Injun sand according to the log of the Keener Hrs. No. 2 (T 24). In the section measured southeast up the hill road along Wells run above Long Reach, page 123, the 12 inches of coal coming 186 feet from the top, appears to represent this bed. Passing east from the Ohio river in Tyler, this coal is found cropping on Pt. Pleasant creek opposite the mouth of Ten mile run, where it is 3 inches thick, coming about 720 feet above tide, and about 50 feet below the Washington bed.

The crop of this coal is exposed along the road leading down Pt. Pleasant creek, ¼ mile northwest of Kidwell where the following section was measured:

		Ft.	In.
1	Massive sandstone forming cliff, Mannington	35	0
2	Shale	5	0
3	Coal, slaty, Waynesburg "A"	0	6
4	Shales and concealed.		

Its elevation here is about 685′ A. T., coming 1570 feet above the Big Injun sand as shown by the log of the Wm. T. Lazier No. 7 well (T 88). This coal crops in the bed of a small branch of Elk fork near the school house, one mile and a half southeast of Kidwell, where is has been mined by stripping, but is only 6 to 8 inches thick, coming about 705 feet above sea level. Its blossom is found exposed along the road leading down Pt. Pleasant creek from Kidwell, and ½ mile south of the latter place is 691′ A. T., coming 1590 feet above the Keener Sand as shown by the log of the A. B. Ankrom No. 1 well (T

86), or about 40 feet greater than at Sistersville. At the mouth of Pt. Pleasant creek the blossom of the Waynesburg "A" coal is exposed on the south side of the stream on the east side of the turnpike, coming about 40 feet above Middle Island creek, or about 690′ A. T. The Washington coal crops 60 to 70 feet higher in the hills. A section here shows as follows:

		Ft.	In.
1	Sandstone, massive, visible, Mannington	10	0
2	Sandy shale	3	0
3	Dark shale and fire clay, **Waynesburg "A"**	1	6
4	Limestone, silicious	1	0
5	Concealed to creek level 30 to	40	0

It appears to be the blossom of this coal at the forks of the road on Gorrell run, 1 mile southeast of Next P. O. where it has an elevation of 733′ A. T., coming 1599 feet above the Big Injun sand as shown by the log of the J. G. Gorrell No. 4 well (T 107). The outcrop of this bed is well exposed where Middle Island creek cuts through the neck of the "Jug". The following section is exhibited here:

		Ft.	In.
1	Sandstone, visible, **Mannington**	6	0
2	Sandy shale	10	0
3	**Coal** ..... 0′ 8″ ⎫		
4	**Slate, black** 0′ 0½″ ⎬ **Waynesburg "A"**	1	7½
5	**Coal** ..... 0′ 11″ ⎭		
6	Red shale	10	0
7	Limy shale and limestone to creek level	5	0

Its elevation here is about 665′ A. T., coming 66 feet below the Washington bed, cropping above.

Its crop is exposed along the road on the north side of Middle Island creek, one mile and a half southeast of Middlebourne, coming about 681′ A. T., or 10 to 15 feet higher than at the neck of the "Jug". At this point it is only 4 inches thick and slaty. Its crop is exposed along the road leading southwest from Middle Island creek to Sancho creek, 1 mile south of Middlebourne. It has the following structure there:

		Ft.	In.
1	Coal, slaty	0	2
2	Shale, dark	4	0
3	Coal	0	3
	Total	4	5

Its elevation here is about 685′ A. T. The parting between the top and bottom coals, is unusually heavy and local, since at every other place noted in the country it rarely exceeds 6 inches.

Passing on up Middle Island creek from the "Jug" region, we find that it was once mined out of the bed, of Blue run at Blue P. O., coming at an elevation of about 695′ A. T. On Indian creek, its blossom is exposed at the sharp bend in the road, 4-10 mile above the mouth of Big run, where it is 5 inches thick, coming immediately over 3 inches of yellow shale, the latter being very persistent at this horizon on Indian and McElroy creeks and other tributaries of Middle Island creek in Tyler county. At this point its elevation is 743′ A. T., coming 397 feet above the Pittsburg bed, and 1732 feet above the Big Injun sand as shown by the log of the M. W. Spencer No. 1 well (T 135). One-half mile below Big Moses the following section is exposed on the north side of the road:

		Ft.	In.
1	Massive sandstone, Mannington 30 to	40	0
2	Concealed and shale	10	0
3	**Coal Waynesburg "A"**	0	2
4	Yellow shale	0	3
5	Shale, gray, to road	3	0

One-third mile northeast of Big Moses, only shale and fire clay occur at this horizon at the base of the great massive Mannington sandstone. Its elevation at this point is 770′ A. T., and it is near the summit of the Big Moses anticline, coming 65 to 70 feet below the Washington bed. On Groves run, southeast of Big Moses, it is 2 inches thick, coming 5 feet below the base of the Mannington sandstone (55 feet thick), and 75 feet below an old opening in the Washington coal.

At the mouth of Woodburn run of Indian creek its horizon is represented by 12 inches of **bituminous shale** over fire clay, coming 7 feet below the Mannington sandstone (25 feet thick), and about 755′ A. T. It is dipping southeast there on the slope of the Big Moses anticline and passes below drainage before reaching Braden Station (Lima P. O.).

On McElroy creek its crop is exposed at the sharp bend of

the road to the left, ¾ mile northwest of Akron P. O., at an elevation of 736′ A. T. A section here shows as follows:

		Ft.	In.
1	Massive sandstone. Mannington	10	0
2	Shale	5	0
3	Coal, slaty, Waynesburg "A"	0	2
4	Shale and concealed to McElroy Creek	40	0

At this point it comes 1722 feet above the top of the Big Injun sand as shown by the log of the Pres. M. Furbee No. 1 well (T 150) close by. It crops in the road just north from the forks of the road at Akron P. O. where the following section is exposed:

		Ft.	In.
1	Coal	0	0 ½
2	Shale, gray	1	3
3	Coal, slaty	0	5
	Total	1	8 ½

Its elevation there is about 750′ A T., coming 418 feet above the Pittsburg coal and 1732 feet above the Big Injun Sand as shown by the log of the D. N. Furbee & Bros. No 4 well (T 153). Where the axis of the Big Moses anticline crosses McElroy creek the Waynesburg "A" coal should come about 770′ A. T., or 70 feet below an opening in the Washington bed on the B. F. Reed farm where the latter has an elevation of 840′ A. T. It dips rapidly on the east flank of this arch, and at Little Pittsburg on Davis run of McElroy is down to 742′ A. T. where the following section is exposed along the road:

			Ft.	In.
1	Concealed			
2	Shale		6	0
3	Coal ..... 0′ 1″			
4	Shale, gray 1′ 6″	Waynesburg "A"	1	9
5	Coal, slaty. 0′ 2″			
6	Shale, yellow		0	1
7	Gray shale			

It passes below McElroy creek just before reaching the Tyler-Doddridge county line. Passing up Middle Island from the mouth of McElroy we find this coal cropping along the road

leading down Little Camp Mistake run to Josephs Mills, at an elevation of 780′ A. T. It is represented here by 6 inches of **bituminous shale,** coming immediately under 40 feet of massive sandstone (Mannington) and over the characteristic yellow shale. The horizon of this bed is exposed on the east side of the road leading up Big run, ⅓ mile southwest of Josephs Mills. A section there shows as follows:

				Ft.	In.
1	Sandstone, massive, **Mannington**			30	0
2	Shale, gray			1	3
3	**Bituminous shale**	0′	2″		
4	Gray shale	1′	0″		
5	Bituminous shale	0′	6″	**Waynesburg "A"**	
6	Slate, black, coaly	0′	1″	1	9
7	Shale, gray to bed of run			1	6

The coal comes about 75 feet below the Washington bed, and 750 feet above tide. It crops along the hill road leading south from Middle Island creek, ¾ mile below the mouth of Camp Mistake run where it is only 2 inches thick, coming at an elevation of 805′ A. T., and directly over yellow shale. It crops along the road leading northwest from Deep Valley in the southern part of Tyler county, coming 791′ A. T. and 61 feet (hand level measurement) below the Washington bed. It crops along the west side of the road leading up Sancho creek, one-third mile below the mouth of Little Sancho creek, where it is represented by a coaly blossom, coming at the base of massive sandstones, 60 feet below an old opening in the Washington bed, 410 feet above the Pittsburg bed and 1635 feet above the top of the Big Injun sand as shown by the log of the J. R. Baker No. 1 well (T 111). A coal was once mined on the south side of Middle Island creek ⅖ mile due east of Shiloh, on the land of Dr. D. C. Smith, that appears to represent the Waynesburg "A" bed, coming as it does 365 feet above the Pittsburg coal and 1555 feet above the Keener sand as shown by the log of the E. J. Osborne No. 1 well (T 61) at Shiloh. Mr. A. J. Stewart of the latter place says the coal was 18 inches thick, but rather slaty and impure. Its elevation at this opening is about 650′ A. T. At Bowles Mills its horizon is represented by 6 inches of **coaly shale,** cropping on the north side of the

road leading west from the village. Its elevation here is 697' A. T., coming 1564 feet above the Keener Sand as shown by the log of the John Lady No. 2 well (T 62) close by. On Little Buffalo run, 2¼ miles east of Friendly station, its horizon is represented by 3 inches of **bituminous shale**, coming about 750' A. T.

In the Marshall-Wetzel-Tyler area, the Waynesburg "A" coal appears to attain a fair development, or reach sufficient thickness to have economical value, in Meade and Franklin districts, Marshall county; Proctor and Magnolia districts, Wetzel county; and Lincoln, Union and Ellsworth districts, Tyler county. Over the rest of the area it seems to be thin and of no economic importance, serving only as a guide or key rock in helping to identify other horizons.

The Mount Morris Limestone.

From 1 to 5 feet under the Waynesburg "A" coal where it crops in Marshall county there often occurs from 6 inches to 3 feet of limestone that has been designated the **Mount Morris limestone**, by Dr. I. C. White[21] from a village of that name in Greene county, Pennsylvania. His original description is as follows:

"Separated from the coal last described by only 2 to 5 feet of clayey shales there sometimes occurs a limestone which although noted, was not named by Stevenson in his Report K. It is well exposed on the north bank of Dunkard creek at Mt. Morris, Greene county, Pa., and has been designated from that locality. This stratum is only 1 to 2 feet thick, and seldom more than 5 feet except in Washington county, Pa., where it is occasionally thicker.

"This limestone is not persistent, and is seldom found south of the Pennsylvania line, being frequently absent even in Greene and Washington counties."

This stratum does not seem persistent in the area under discussion except in Marshall county. In the core tests at Mobley

21. Bulletin 65, page 39-40, U. S. Geol. Survey.

and Jacksonburg, (W 150) and (W 177) respectively, the interval between the Waynesburg "A" coal and the top of the Waynesburg sandstone is occupied by fire clay, according to the log furnished the Survey by the company drilling the tests.

The Waynesburg Sandstone.

At 15 to 20 feet below the Waynesburg "A" coal, a massive rock comes into the measures that was long ago designated the Waynesburg sandstone by the First Geological Survey of Pennsylvania from its fine development near a town of that name in Greene county, Pa. In Bulletin 65, page 40, of the U. S. Geological Survey, Dr. I. C. White has the following to say concerning this formation:

"It is one of the most persistent members of the Permo-Carboniferous series, since its eastern outcrop can be followed in an almost continuous line of cliffs from Greene county, Pa., clear across West Virginia to the Big Kanawha river at Winfield.

"This stratum is the only one of the series[22] that is generally conglomeratic or contains quartz pebbles larger than coarse sand grains. On account of this peculiarity the rock in question becomes a very important guide to the geologist in the interior of West Virginia, where so many of the Dunkard coals and limestones have disappeared, for it retains its pebbly character over a very wide area. When at its greatest development the thickness of this stratum approaches 75 to 100 feet. It is usually a grayish-white rock, with a yellowish cast on freshly broken surfaces, and its weathered boulders are ususally covered with ridges and streaks of harder iron-bearing sand. The rock splits readily and frequently furnishes excellent building stone, the piers of the Baltimore and Ohio R. R. bridges across the Monongahela river near Fairmont having been constructed of it."

Along the western border of the 3 counties where it outcrops, it has thinned down considerably and sometimes is represented only by sandy beds. In central and eastern Wetzel

22* Referring to the Dunkard Series.

county, although deeply buried, it retains its massive character as shown by the log of the core tests at Jacksonburg and Mobley, (W 177) and (W 150) respectively. In the former its thickness is reported 40 feet 8 inches, coming 5 feet 2 inches above the Waynesburg coal, and in the latter, 49 feet thick, coming only 1 foot above the Waynesburg coal.

This stratum crops just above stream level on both sides of Wheeling creek clear across Marshall county. Along the hill road leading northwest from Majorsville its horizon is represented by 35 feet of sandy shales with streaks of thin sandstones, but along the road leading north from Wheeling creek, 2 miles west of Majorsville, 35 feet of sandstone occurs at this horizon, coming 15 feet above the Waynesburg coal.

Along the Ohio river front of Marshall this stratum is represented by 5 to 10 feet of sandstone in the McMechen section, and in the section at Moundsville 25 feet of sandy shale and flaggy sandstone is found at this horizon. In the sections measured at the mouth of Hog run, Captina, and Franklin station its horizon is represented by sandy beds and thin sandstones.

In the Steelton section measured down the ravine at the northern point of Magnolia district, Wetzel county, page 156, this stratum is 35 feet thick and quite massive, forming a cliff at this point. There it comes 3 feet above the Elm Grove limestone and 15 feet above the Waynesburg coal horizon. Its outcrop is exposed at New Martinsville at the forks of the road, ⅓ mile north of the mouth of Doolin run, where it is represented by 15 to 20 feet of flaggy sandstone with its base coming about 645′ A. T. and 110 feet below the blossom of the Washington coal the latter being exposed along the road leading up the point between Doolin run and Fishing creek at an elevation of 754′ A. T. From this point on down the river to the Tyler county line at Paden City, its horizon is largely concealed by old terrace deposits.

In the section measured down the river hill, 1 mile northeast of Sistersville, Tyler county, page 120, this stratum is represented by 8 feet of flaggy and massive sandstone, coming 16 feet above the Waynesburg coal, and 101 feet above the Uniontown bed. In the Long Reach section, page 123, the 20 feet of mas-

sive sandstone 192 feet from the top, possibly represents this horizon, coming as it does 5 feet below what the writer has identified as the Waynesburg "A" coal.

In the McKim section, page 118, the greater portion of which was taken from the log of the Moses Johnson No. 1 well (T 229), it appears that possibly the Waynesburg and Mannington sandstones have coalesced to form a great sandstone 85 feet in thickness.

In the eastern part of Tyler on Big run of Indian creek the log of the W. W. Myers No. 1 well (T 137), page 114, reports 50 feet of slate at this horizon. The detailed log of the Elizabeth Stoneking No. 1 well (T 140) on Woodburn run of Indian creek, 2 miles northeast of Big Moses, reports only slate and lime at this horizon.

The Elm Grove Limestone.

At 5 to 10 feet above the Waynesburg coal in Marshall and western Wetzel counties there often occurs a dark flaggy limestone, from 1 to 5 feet in thickness that has been designated the **Elm Grove limestone** by Prof. G. P. Grimsley[23] from its outcrop at the town of that name in Ohio county, W. Va. His original description is as follows:

"Through Ohio and Brooke counties a very persistent limestone is found a few feet above the Waynesburg coal. It varies in thickness from 30 inches to 10 feet and has a deep blue or black color. It weathers into thin shaly layers almost like a slate, which give its outcropping edges a peculiar straited appearance. This limestone in some places rests directly on the coal, but more often is separated from the coal by five to eight feet of shales.

"This characteristic limestone was found with the Waynesburg coal in the northwestern part of Marshall county, through most of Ohio and in Brooke county. In no place where the overlying layers of the coal were exposed was the limestone absent. It thus serves as a valuable guide in the identification

23* Ohio-Brooke-Hancock Report, page 68. W. Va. Geol. Survey.

of the Waynesburg coal, since its appearance is so different from that of the other limestones in the series.

"This limestone is well shown near Elm Grove, and east from this town near the National road, where in the ravines to the south it reaches its maximum thickness, and the writer has therefore named the rock the Elm Grove Limestone.

"A sample of this limestone from near Middle Wheeling creek was analyzed in the Survey Laboratory with the following results which show it to be a very silicious rock and a very impure limestone:

	Per cent.
Lime carbonate	56.61
Magnesium carbonate	1.82
Iron and alumina oxides	4.00
Silica	31.20
Water and organic matter	5.79
	99.42

In the section measured down the river hill at McMechen this limestone was 5 feet thick, dark and flaggy coming 2½ feet above the Waynesburg coal. At the north end of the narrows the crop of this stratum is exposed. Only 3 feet is visible there, coming 7 feet above the Waynesburg coal. In the section on Middle Grave creek, page 83, 2 feet of the top portion of this stratum dark and flaggy, is noted coming 88 feet below the Washington coal. Its outcrop is observed along the hill road leading south from the mouth of Grave creek at Moundsville, where it is 4 feet thick, coming 4 feet above the Waynesburg coal.

Its crop is exposed along the road leading east up the hill from Powhatan station, where only 8 inches is visible, coming 7 feet above the Waynesburg coal. Its horizon is exposed along the road leading east up the hill from Franklin station, but the limestone appears to have thinned away.

This stratum was observed at only one point in Wetzel county and this was at the place where the Steelton section, page 156, was measured down the river hill, in the extreme northern part of Magnolia district, Wetzel county. There 2 feet of the top portion, dark gray and flaggy, was exposed.

coming 48 feet below the Waynesburg "A" coal and 9 to 10 feet above the horizon of the Waynesburg bed.

It was not definitely recognized in Tyler county.

The Cassville Plant Shale.

The shale ranging in thickness from 1 to 15 feet, coming directly over the Waynesburg coal has been designated the Cassville Plant Shale by Drs. Fontaine and White from a village of that name in Monongalia county, West Virginia, where they found this stratum to be rich in fossil plants, many of which are of Permian age.

Age of the Dunkard Series.

In his report on Ohio, Brooke and Hancock counties, of West Virginia, pages 69-77, Prof. G. P. Grimsley gives the following admirable account of the age of the Dunkard series:

"After a geological examination of the rock strata in several of the provinces of Russia in 1841, Sir Roderick Murchison, the great English geologist, proposed a system to include the uppermost rocks of the Paleozoic group, the name being taken from the old province of Perm, where these rocks were typically exposed.

"The system, known as the Permian or Dyas was later subdivided in western Europe.

Zechstein	Upper.
Rothliegende	Middle.
	Lower.

"The upper **Zechstein** division consists mainly of limestones and dolomites, while the lower, or **Rothliegende,** is made up of red sandstones, conglomerates, and shales.

"In America the existence of Permian rocks has long been a subject of discussion which has resulted in much difference of opinion. The discussion was started in 1857-8 by identification as Permian of a collection of fossils made in Kansas by Hawn and described by F. B. Meek. Meek believed in the ex-

istence of the Permian in Kansas as established by the presence of these Permian fossils. This opinion was accepted by such geologists as Swallow, Broadhead, Hayden, Geinitz, and Marcou who claimed to have first suggested the existence of Permian in this country in 1853. The interest in the Permian question apparently ended about 1868 and the problem was considered as unsolved.

"In 1885 Dr. Newberry, at the Berlin International Geological Congress is reported as stating, 'He had traversed all the States and Territories of the Union and had examined the so-called Permian in many localities, but in his judgment it could not be separated from the Coal Measures.'[24]

"In 1889 and 1891, the Russian geologist, Tschernyschew, and also Waagen, assigned the beds near Nebraska City, Nebraska, to the Permo-Carboniferous.

"In 1890 Prof. W. F. Cummins divided the Permian of Texas into three divisions and named them from the base upward: Wichita, Clear Fork, and Double Mountain beds. From the Wichita, Professor Cope described fossil vertebrates as Permian in age. Dr. I. C. White identified the fossil flora of the Wichita as similar to the flora above the Waynesburg coal in Pennsylvania and West Virginia. Waagen correlated the Wichita with the Zechstein division of the Permian in Europe.[25]

"In 1895 Professor Prosser published a classification of the Upper Paleozoic rocks of Central Kansas,[26] and placed his Neosho and Chase formations fomerly called Permo-Carboniferous, in the Permian. Professor Prosser has made very careful studies in these formations extending over a period of several years. The result of this work has been the recognition by most geologists of the existence of the Permian system in Kansas and Nebraska. The investigations of Cope, I. C. White and W. F. Cummins have accomplished a similar result in Texas.

"In the Appalachian area of Pennsylvania, Ohio, West Virginia, and Maryland the fossil vertebrates are absent in the

24. Quoted by Prosser, Jour. Geol., Vol. III., p. 790.
25. Geol. Survey Texas, Vol. IV., p. 225.
26. Jour. of Geol., Vol. III., p. 795.

highest rocks of the Carboniferous, and no extended collections of invertebrates, except insects at one or two localities, have been made. The evidence for Permian strata rests mainly on the fossil flora.

"It was in 1880 that Drs. Fontaine and I. C. White published the report of Pennsylvania Geological Survey (PP) on the Permian or Upper Carboniferous Flora of West Virginia and Southwestern Pennsylvania, in which they reached the conclusion that the Upper Barren Measures (later named Dunkard) were Permian in age.

"While in this report the authors gave almost conclusive proof for the Permian age of these beds, American geologists seemed adverse to accepting the conclusion.

"Fontaine and White determined that 'out of 107 fossil plants found in these measures in West Virginia, 22 occur in the Coal Measures proper, while 28 are found also in the Permian of Europe. Of the 22 species which are common to the Upper Barrens and to the Coal Measures below them, 16 are also found in the European Permian, leaving six not hitherto found in the Permian,' (p. 111).

"Of the 28 species common to the Upper Barrens and the European Permian, 12 have never been found in the Coal Measures of the United States (marked by * in list below) and two are exclusively Permian, namely, **Callipteris conferta** and **Alethopteris gigas.**

Species Common to Upper Barrens and European Permian.[27]

*Equisetites rugosus
Calamites suckowii.
*Sphenophyllum longifolium.
*Annularia carinata.
Annularia longifolia.
Annularia sphenophylloides.
Annularia radiata.
Annularia minuta.
Neuropteris flexuosa.
Neuropteris auriculata.
Neuropteris cordata.
*Odontopteris obtusiloba.
*Callipteris conferta.
Pecopteris arborescens.
Pecopteris Candolleana.
Pecopteris oreopteridia.
*Pecopteris pennaeformis lactifolia.
Pecopteris Miltoni.
Pecopteris dentata.
Pecopteris pteroides.
Pecopteris Pluckeneti.
*Pecopteris Germari.
Goniopteris emarginata.
Goniopteris elegans.
*Alethopteris gigas.
Rhacophyllum filiciforme.
Rhacophyllum lactuca.
*Sigillaria Brardii.

27. 2nd Geol. Survey Penn., P. P., p. 105.

"The authors sum up the evidence for the Permian age of the Upper Barren Measures (Dunkard) as follows:[28]

"1. The evidence from the identity of species.

"2. The evidence from allied species.

"3. The evidence from the decadence of coal measure forms.

"4. The introduction of types characteristic of later formations.

"5. The existence of an important physical change at the beginning of the Series.

"6. The nature of the lithology; the disappearance of coal; the diminution in the amount of plant life.

"In 1902 Dr. David White, the well known paleontologist of the United States Geological Survey, re-examined the localities described by Fontaine and I. C. White, and made new collections of the fossil flora. In a paper read before the Geological Society of America at the close of that year he classified the fossils found in the Dunkard Series as follows:[29]

"Species Characteristic of Rothliegende or Higher Formations of the Old World."

Callipteris conferta (typical).
" lyratifolia var coriacea.
" curretiensis.
Goniopteris Newberryiana.
Pecopteris germari.
Alethopteris gigas.
Odontopteris obtusiloba.
Caulopteris gigantea.
Equisetites rugosus.
Sphenophyllum fontaineanum.
" tenuifolium.
Sigillaria approximata.

Species Closely Allied to Old World Permian Types.

Cymoglossa obtusifolia.
Goniopteris elliptica.
Pecopteris asplenioides.
" rarinervis.
" Schimperiana.
" dawsonianum.
Pecopteris odontopteroides
Alethopteris virginiana.
Odontoperis nervosa.
" pachyderma.
" sp. nov.
Neuropteris flexuosa var. longifolia.

---

28. Second Geol. Survey Penn. PP., page 120.
29. Bull. Geol. Soc. America, Vol. 14, p. 539.

Species Whose Habit or Facies Suggest a Late Date (Mesozoic).

Equisetites striatus.
Nematophyllum angustum.
Pecopteris dentata.
" odontopteroides.
Sphenopteris pachypteroides.
Sphenopteris pachynervis.
Saportaea grandifolia.
Jeanpaulia (Boiera) virginiana.
Taeniopteris newberryana.

Species Which Represent Coal Measure Types.

Pecopteris dentata.
" emarginata.
* " elegans.
" arguta.
" pennaeformis.
" arborescens.
* " orcopteridia.
* " Miltoni.
" Candolleana.
* " pteroides.
* " Pluckeneti.
* " grandifolium.
Neuropteris fimbriata.
Neuropteris flexuosa.
" hirsuta.
" auriculata.
*Aphelebia filiciformis.
Calamites Suckowii.
Asterophyllites equisetiformis.
*Annularia stellata.
* " radiata.
" sphenophylloides.
*Sphenophyllum filiculme.
* " longifolium.
* " oblongifolium.
*Sigillaria brardii.

(Species marked * reported in Lower Rothliegende but common in older formations).

"Dr. David White in the above quoted paper (p. 541) concludes from the study of fossil plants so far found in the Dunkard Series that 'On account of the small number of species which may be considered as in a measure characteristic of the Rothliegende, the absence from the latter of Callipteris, the old world Dyassic Odontopteris and Callipteridium, and the extreme rarity of the types of later facies, it appears that the beds below the Lower Washington limestone cannot yet be regarded as conclusively referable to the Rothliegende, though they contain a flora which is certainly transitional. The re-enforcement of this flora at the levels of the Washington and Dunkard coals by the more important and distinctly characteristic Rothliegende species mentioned above seems to fully justify the reference of the latter to the Rothliegende, the lower boundary of which may probably be safely drawn as low as the Washington limestone. which is as yet the lowest observed Callipteris horizon. Further search in the floras of the lower beds of the Dunkard and in the Monongahela is necessary before the Upper boundary of the Coal Measures can be definitely ascertained. The flora of the

upper portion of the Dunkard is to be compared with those of the Stockheim and Cusel beds in Germany and of the series in the basin of Brives in France. * * *

"'Our highest Appalachian Paleozoic beds do not appear, so far as yet studied paleobotanically, to extend above the Lower Rothliegende of western Europe. The Zechstein, if originally present, as seems not unlikely, has long since disappeared. The reference of the greater part of the Dunkard to the Lower Rothliegende appears to be well founded; but it seems to the writer as probable that the plants of the Upper Dunkard or of the lowest of the terraces of western Europe that are now generally classed as Rothliegende are hardly of so late a date as the flora of the Artinsk stage of Russia.'

"The conclusions of Dr. David White agree for the most part with those of Fontaine and I. C. White and give additional weight to the belief in Permian age of the Dunkard Series.

"Professor Prosser in a recent review of the question of the Permian age of the Dunkard Series writes,[30] 'A number of European geologists have accepted Permian as the age of the Dunkard formation, and Dr. Frech states that the Dunkard Creek beds and Cassville plant shale, the latter of which is the shale at the base of the Dunkard formation immediately overlying the Waynesburg coal, are the equivalent of the Cusel stage which is the oldest division of the Lower Rothliegende of Germany. And in another sentence is the statement that the petrographical and paleontological similarity of the Dunkard with the Rothliegende of Western Europe is therefore beyond doubt. Dr. Kayser also puts the Dunkard in the Permian, and he has made the following statement concerning its age: In the United States we find in the east (Virginia, Pennsylvania, etc.) in conformable layers upon the upper Carboniferous the so-called Barren Measures with **Callipteris conferta, Taeniopteris** and other Permian characteristic forms together with typical Carboniferous plants as representative of the Permian.'

"Professor Scudder published descriptions of the fossil insects found in the Cassville shales in Bulletin 124, U. S.

30. Geol. Survey of Ohio, Bull No. 7, Revised Nomenclature of the Ohio Geological Formations, p. 6, 1905.

Geol. Survey. He states that this fauna is unquestionably younger than any known from the Pennsylvania or Illinois rocks. Fifty-six species were described, belonging to five genera, but thirty-six of them were of one genus, **Etoblattina.**

"The only occurrence of a similar form to many of these species (25 per cent) of Etoblattina and Gerablattina, Professor Scudder says, is the **Etoblattina elongata** from the Lower Dyas of Weissig, Saxony. The genera described by Professor Scudder from the Cassville shale are, Etoblattina with 36 species; Poroblattina, three species; Petrablattina, one species.

"With the evidence now available and the opinions of able scientists who have made special study of the Permian problems, there would seem to be little ground for doubting the Permian age of a large portion of the Dunkard, if not all. The fossil plants in the upper portion of the series certainly indicate a Permian age, and the fossil insects in the lowest part would indicate these strata to be Permian.

Fossil Plants from the Dunkard Series in Ohio Co., W. Va.

"The roof shales of the Washington and Dunkard coals in Ohio county usually contain a large number of fossil leaves, but in the same locality they show considerable uniformity in characters. A number of these fossils were collected in the vicinity of Valley Grove, Ohio county, and sent to Prof. William M. Fontaine, of the University of Virginia, who has kindly examined them. The following fossil plants were identified by Professor Fontaine from this material, and his comments on the forms are included:

"The specimens from the shales ten feet below the Washington coal on the Taggart farm, on McGraw's run, one-half mile west of Valley Grove, show the following types:

"Pecopteris tenuinervis.

"Pecopteris platynervis.

"Neuropteris flexuosa.

"Equisetites elongatus? obscure imprint.

"Practically all the plants here are **Pecopteris tenuinervis** and **Pecopteris platynervis,** the former predominates and both show some good specimens. They occur mostly in forms with

pinnules of smaller size than the average. **Neuropteris flexuosa** occurs in only three obscure imprints, and the fossil suggesting **Equisetites elongatus** in only one doubtful form. This confirms the deductions drawn in the Pennsylvania Geological report PP., viz.: that the Upper Barren (Dunkard) flora is noteworthy for the very few species found at each locality, these, however, being represented by many individuals for the predominating forms.

"The roof shales of the Washington coal one-half mile south of Valley Grove yielded the folowing fossils:

"Neuropteris flexuosa.

"A Neuropterid pinnule apparently rachial.

"Nearly all the fossils at this locality are **Neuropteris flexuosa.** They are very numerous. A few pinnules of much larger size occur, but they are imperfectly preserved and do not show full character. These pinnules have a divergent cyclopteroid nervation, and they are probably the clasping rachial pinnules of Neuropteris flexuosa.

"From the roof shales of the Dunkard coal on the Atkinson farm, one mile and a half east of Valley Grove, the following plants were identified:

"Neuropteris odontopteroides.

"Neuropteris hirsuta.

"Neuropteris flexuosa.

"Neuropterid rachial pinnules, probably of Neuropteris hirsuta?

"Alethopteris gigas.

"Callipteridium oblongifolium.

"Strap shaped imprints of epidermal tissue, suggesting a plant of Calamitean affinity.

"Imprints of woody stems.

"This locality is richer in species than any of the others, and it seems to be a promising one for furnishing a representation of the flora of the higher horizons of the Upper Barrens (Dunkard).

"There are several impressions of **Neuropteris odontopteroides,** but the plant is rare, and the same may be said of **Alethopteris gigas. Callipteridium oblongifolium** is next to

Neuropteris hirsuta the most common, and it is generally in fructified forms. **Neuropteris hirsuta,** the most common form, occurs in a great number of detached pinnules, mostly fragmentary. Neuropterid rachial pinnules occur here also, that probably belong to Neuropteris hirsuta, but they are larger and coarser with stronger nervation than those found in the roof shales of the Washington coal one-half mile south of Valley Grove. **Neuropteris flexuosa** occurs here in only two or three small fragments of pinnæ. Several imprints of epidermal tissue and of woody stems occur, but they do not show definite characters.

"The roof shales of the Washington coal south of Roneys Point on Point Run give a few poor specimens of the **Neuropteris flexuosa,** and in the pipe line ditch near Reeds Mill these roof shales give four good imprints of **Pecopteris tenuinervis.**

"Over the Dunkard coal in the railroad cuts one mile and a half east of Valley Grove were several imprints of **Neuropteris flexuosa** and **hirsuta.**"

CHAPTER V.

THE MONONGAHELA SERIES

This series of rocks begins at base with the bottom of the Pittsburg coal and extends up to the Cassville Plant Shale or to the top of the Waynesburg coal, an interval varying in thickness from 260 feet in the northwest corner of Marshall county to over 375 feet in southeastern Wetzel county, or over 400 feet in the central portion of the Appalachian basin. **The Monongahela Series** was named by Prof. H. D. Rogers on account of the great development of its coal seams along the river of that name in Pennsylvania. The following description of this series of rocks is given by Dr. I. C. White in Volume II. of the W. Va. Geological Survey reports, pages 124-125:

"In the northern part of the State nearly one-half of the rock material composing the Monongahela series is limestone, red shales are unknown, while massive sandstones are seldom found except along the eastern side of the Monongahela outcrop. The disintegration of these limestones, limy shales and other soft rocks at the north, gives origin to a gentle topography and an extremely fertile soil, thus forming in Monongalia, Marion, Harrison, Lewis, Marshall, Ohio and Brooke counties, as well as in portions of Upshur, Barbour and Taylor the finest agricultural and grazing regions in the State.

"In passing southwest from Harrison, Taylor and Lewis counties, however, the limestones practically disappear, along with most all of the coal beds, while red shales come in as the limestones go out, apparently replacing the latter, and the sandstones grow more massive than in the northern area, thus giving origin to a rugged topography and less fertile soils.

"These rocks extend over a wide area along the Ohio river and for many miles south of it, as far as the Great Kanawha, and in a narrow belt from that point to the Big Sandy, where in

the center of the Appalachian trough, the lowest of these beds passes into the air before reaching the Kentucky line.

"No marine fossils have ever been discovered in any of the limestones of the Monongahela series, and every thing indicates that the deposits are of fresh water origin. The black slates always contain fish remains in the shape of scales and teeth, but nothing is known of their affinities, because they have never been studied. The water may have been estruarine and slightly brackish, but the minute Cyprian and Estherian-like forms whose skeletons—mostly broken and pulverized—make up the principal mass of the Monongahela limestones, testify clearly against their marine origin."

The first study of the Monogahela series in detail was made in the State of Pennsylvania and for this reason the names given to its various formations are taken from localities in that State.

A section of the Monongahela series, measured by Dr. I. C. White on Scotts run, Monongalia county, W. Va., between Cassville and Osage, a short distance west from the Monongahela, and published in Bulletin No. 65, U. S. G. Survey, page 47, gives the following results for the eastern side of the Appalachian basin:

Scott's Run Section.

		Ft.	In.	Ft.	In.
Coal, Waynesburg	coal ..... 2′ 0″				
	shale, fossiliferous 1′ 0″				
	coal ..... 1′ 4″			10	10
	shale, gray ..... 1′ 6″				
	coal ..... 5′ 0″				
Black slate		1	0		
Sandy shales, with iron ore		25	0		
Limestone, Waynesburg		8	0	99	0
Sandy shales, with limestone layers		30	0		
Sandstone massive		20	0		
Limestone and shales		15	0		
Black slate, representing Uniontown coal				2	0
Limestone, interstratified with thin shales, cement beds near base		105	0	145	0
Sandstone, Sewickley		40	0		
Coal, Sewickley				5	0

	Ft.	In.	Ft.	In.
Shales	5	0		
Sandstone	10	0		
Limestone	5	0		
Shales, greenish gray	8	0	65	0
Concealed	15	0		
Limestones, steel gray	7	0		
Concealed	15	0		
Coal, Redstone			4	00
Limestone, Redstone	18	0		
Shale and fireclay	5	0	28	0
Slate, black	5	0		
Coal, Pittsburg "Roof" — coal 0′ 3″; shale 2 0; coal 1 0; clay 1 0	4	3		
Coal, Pittsburg, Main Bench — coal 3′ 6″; slate 0 ½; coal 0 8; slate 0 1; coal 1 6; slate 0 ½; coal 0 6; slate 0 ½; coal 3 3	9	7½	13	10½
Total			372	8½

A section carefully hand-leveled by the late Prof. C. N. Brown of the Ohio Geol. Survey, and published in Vol. VI., pages 617-19 Ohio Geological Survey, will serve to show the character and intervals between the various formations of the Monongahela series near Bellaire, Ohio, just across the Ohio river from the northwest corner of Marshall county. It reads as follows as interpreted by Dr. I. C. White in Bulletin 65 U. S. G. Survey, page 50:

Section Near Bellaire, Belmont County, Ohio.

	Thickness Ft.	Total Ft.
Coal, Waynesburg	2.0	2.0
Shales, sandy	6.0	8.0
Shales	12.0	20.0
Limestone	3.0	23.0
Concealed	5.0	28.0
Coal blossom, Little Waynesburg	0.0	28.0
Concealed	14.0	42.0
Coal blossom, Uniontown	0.0	42.0
Shales	4.0	46.0
Sandstone	6.0	52.0

	Thickness Ft.	Total Ft.
Shale, argillaceous	20.0	72.0
Concealed	32.0	104.0
Shales	2.0	106.0
Sandstone	3.0	109.0
Shales	3.0	112.0
Concealed	33.0	145.0
Calcareous shale with thin limestone	24.6	169.6
Coal and shales, Sewickley	27.6	197.0
Shales, argillaceous	2.0	199.0
Limestone, thin clay in center	8.0	207.0
Limestone, magnesian, cement rock	5	212.0
Clay	1.0	213.0
Limestone	11.0	224.0
Concealed	11.0	235.0
Coal blossom, Redstone	2.0	237.0
Concealed	17.0	254.0
Shales	1.0	255.0
Coal, Pittsburg	17.0	262.0

A section measured with hand level by Prof. G. P. Grimsley one mile east of Elm Grove, Ohio County, W. Va. on Peters run at the Creighton slope mine, a short distance (2 miles) north from the Marshall county line, gives the following exposures for the Monongahela series, showing a split of the Sewickley coal into 2 beds, 22 feet apart:

Creighton Slope Mine and Hill Section[1].

	Thickness Ft.	Thickness In.	Total Ft.	Total In.
Coal blossom, Waynesburg	2	0	2	0
Shales, sandy	7	8	9	8
Limestone, gray	2		11	8
Concealed	46	8	58	4
Limestone, gray, nodular, Uniontown (?)	3		61	4
Sandstone	4		65	4
Concealed and sandy shales	60		125	4
Limestone, blue	10	4	135	8
Concealed	25	10	161	6
Coal, Upper Sewickley	2		163	6
Top of Slope Mine.				
Shales	22		185	6
Coal, Lower Sewickley	2		187	6
Limestone and shales	64		251	6
Pittsburg coal	5		256	6

Another section, measured with hand level by Prof. Grimsley from actual exposure along the hill road leading down Chap-

1. Ohio-Brooke-Hancock County Report, p. 81, W. Va. Geol. Survey.

line hill at Wheeling, on the Ohio river front, 2¼ miles north from the Marshall county line, is given to show the relative position of the Redstone and Sewickley coals, and that a "split" in the latter bed really exists. This section is as follows:

Chapline Hill, Wheeling, Section.

	Thickness. Ft.	In.	Total. Ft.	In.
Waynesburg coal	2	0	2	0
Shales	6		8	0
Black slate	0	0	8	0
Buff shales	4	4	12	4
Shaly sandstone	3		15	4
Buff shales	3		18	4
Gray limestone, Waynesburg	2		20	4
Thin sandstone and shales	30	4	50	8
Clay blossom, Uniontown Coal Horizon (?)		8	51	4
Sandstone	0	6	51	10
Buff shales	6		57	10
Limestone, Uniontown	4		61	10
Buff shales and sandstone	41	4	103	2
Green shale (Fulton)	4		107	2
Limestone and shales, Benwood	86	8	193	10
Sewickley Coal	0	6	194	4
Limestone, Sewickley	33		227	4
Redstone Coal		8	228	0
Limestone, Redstone	18		246	0
Shales (in part of area)	10	6	256	6
Pittsburg coal { roof..... 1′ 2″ / shales .. 1′ 0″ / coal..... 5′ 0″ }	7	2	263	8

Only a narrow belt of the Monongahela series of rocks in the Marshall-Wetzel-Tyler area are exposed, along the Ohio river front, and along the main channel of Wheeling creek. The outcropping rocks of the 3 counties with the above exception are all of the Dunkard series. The entire Monongahela series outcrops at only one point in the area, the northwest corner of Marshall county, since the Pittsburg coal dips rapidly south and east, passing below the Ohio river at the new U. S. Government lock and dam at McMechen, and remains under until below St. Marys, W. Va., where its horizon is brought up by the Volcano-Burning Springs Anticlinal. The main source of information as to the character, thickness, etc., of its rocks has been from the logs of a large number of oil and gas wells drilled down into the Devonian. Also from the logs of several diamond drill

borings, the latter being much more trustworthy in determining the quality of the material passed through.

J. V. Thompson of Uniontown, Pa., put down a diamond drill boring on the Wm. W. Ewing land (M 15) on the north bank of Wheeling creek, about 3,000 feet southwest of Viola, Marshall county that starts only 5 to 10 feet below the Waynesburg coal (with partings 4 feet thick) and passed down through the Pittsburg coal. The log of this core test was kindly furnished the Survey by Mr. C. McC. Lemley, Asst. Engineer, B. & O. R. R. Co., and it reads as follows:

Diamond Drill Hole on Wm. W. Ewing Land, Near Viola, W. Va.

		Thickness		Total.		
		Ft.	In.	Ft.	In.	
1	Surface	27	0	27	0	
2	Shale	1	6	28	6	
3	Blue limestone	0	6	29	0	
3-A	Gray shale	6	10	35	10	
4	Blue limestone	0	8	36	6	
5	Green sand shale	27	0	63	6	
6	Dark sand slate	0	10	64	4	
7	Limestone	1	1	65	5	
8	Dark sand slate	1	5	66	10	
9	Blue limestone	8	4	75	2	
10	**Green shale, Fulton**	4	6	79	8	
11	Blue limestone	9	0	88	8	
12	Gray slate	5	5	94	1	
13	Blue limestone	27	5	121	6	
14	Gray shale	2	1	123	7	
15	Blue limestone	7	0	130	7	105' 11"
16	Dark sand slate	4	6	135	1	
17	White limestone	1	4	136	5	
18	Dark sand shale	1	11	138	4	
19	White limestone	5	8	144	0	
20	Dark sand shale	5	8	149	8	
21	White limestone	2	9	152	5	
22	Dark sand shale	2	11	155	4	
23	White limestone	0	10	156	2	
24	Dark sand shale	1	0	157	2	
25	Blue limestone	12	5	169	7	
26	Green shale	0	10	170	5	
27	Blue sandstone	8	6	178	11	
28	Fire clay	4	8	183	7	
29	Unrecorded	2	0	185	7	
30	Sand slate	7	6	193	1	
31	Unrecorded	0	6	193	7	
32	Sand slate	2	5	196	0	
33	Blue limestone	14	0	210	0	
34	White limestone	24	6	234	6	

		Thickness Ft.	In.	Total. Ft.	In.		
35	Dark sand shale	1	1	235	7		
36	Blue limestone	5	0	240	7	62′	10″
37	Green shale	0	8	241	3		
38	Blue limestone	1	6	242	9		
39	Gray slate	5	0	247	9		
40	Coal, (Redstone)	0	8	248	5		
41	Blue limestone	12	0	260	5		
42	Dark sand slate	10	0	270	5		
43	Limestone	1	0	271	5		
44	Fire clay	5	3	276	8	24′	2″
45	Coal.... 0′ 11″						
46	Fire clay 0′ 4″ **Pittsburg coal**	7	11	284	7		
47	Coal.... 6′ 8″						

The total thickness of the Monongahela series here is about 305 feet. The Uniontown coal is not represented. No. 10 formation appears to represent the **Fulton Green Shale.** Formation No. 29 may represent the Upper Sewickley coal, and most likely was purposely omitted from the log. The Redstone coal is thin and unimportant, but the Pittsburg coal is present in good thickness, having 11 inches of its characteristic "roof" coal. The log of the John Armstrong well (M 33) in the northeastern corner of Marshall county, 1 mile southwest of Dallas, shows the Monongahela series in that region to have a thickness of 323 feet.

At Majorsville the Waynesburg coal crops 20 feet above the top of the S. T. Alley No. 2 well (M 34) drilled by the Virginia Oil & Gas Co. A section there in connection with the log of this well shows as follows for the Monongahela series:

Section at Majorsville, Marshall County.

	Thickness Feet.	Total. Feet.	
Coal, Waynesburg, with partings	4	4	
Concealed to top S. T. Alley No. 2	20	24	
(S. T. Alley No. 2 well Record)			
Conductor, (surface gravel)	12	36	
Limestone	20	56	
Slate	10	66	
Limestone, hard	23	89	
Slate	10	99	197′
Limestone	25	124	
Slate	5	129	
Limestone	10	139	
Slate	10	149	
Limestone, hard, cement rock	30	179	
Limestone	15	194	
Coal, Upper Sewickley, little gas	3	197	

	Thickness Feet.	Total. Feet.	
Slate	7	204	
Limestone	20	224	
Slate	5	229	
Limestone	30	259	102′
Slate	15	274	
Slate	28	302	
Coal, Pittsburg	7	309	

The Uniontown and Redstone coals, if present, were too thin to be noted or taken account of by the well driller.

The log of the Upton Dorsey No. 1 well (M 21), located on Granny run of Wolf run, 3 miles southwest of Majorsville, gives the following succession for the Monongahela series according to the South Penn Oil Co.:

Section 3 Miles Southwest of Majorsville, Marshall Co.

	Thickness Feet.	Total. Feet.
Coal, Waynesburg	5	5
Unrecorded	202	207
Coal, Sewickley	4	211
Unrecorded	81	292
Coal, Pittsburg	6	298

The top of the Waynesburg coal was struck at a depth of 198 feet, and the top of the Washington coal 4 feet thick at a depth of 60 feet.

About 3 miles farther southwest of this point on Wolf run the detailed log of the J. T. Cox No. 1 well (M 24) shows the Monongahela series to have a thickness of 290 feet. The record of the Brice Howard Heirs No. 1 well (M 66), ¾ mile south of Cameron, shows the Monongahela series to have a thickness of 305 feet in this portion of Marshall county. In this well the top of the Waynesburg coal was struck at a depth of 609 feet.

In the southern portion of Marshall county, on the south bank of Fish creek, 1 mile west of Bellton (Denver Sta.) the log of the J. L. Hoffman No. 1 well (M 119) gives the following succession for the Monongahela series:

	Thickness Feet.	Total. Feet.
Coal, Waynesburg	3	3
Unrecorded	192	195
Coal, Sewickley, Upper	4	199
Unrecorded	114	313
Coal, Pittsburg	6	319

In this well the top of the Waynesburg coal was struck at a depth of 305 feet and the top of the Big Injun sand at a depth of 1828 feet or 1210 feet below the top of the Pittsburg coal. Farther down Fish creek in Meade district near the mouth of Upper Bowman run, the Monongahela series is shown to have a thickness of 301 feet by the log of the J. W. West No. 1 well (M 48) in which the top of the Waynesburg coal was struck at a depth of 175 feet. The Washington coal, 2 feet thick, was found at a depth of 60 feet in the same well, making the Washington-Waynesburg coal interval there 113 feet.

On Whetstone run, 3.3 miles southwest of the latter point, Mr. J. E. Barnes of Uniontown, Pa., put down a core test well (M 95) on the Anderson farm, the record of which was published by Dr. I. C. White in Vol. II., pages 131 and 132, of the Survey reports. This is a very important record and for this reason is repeated here as follows:

Anderson Farm Boring Record.

	Ft.	In.	Ft.	In.
Coal, Waynesburg			2	0
Sandstone	2	0		
Shale	6	0		
Sandstone	3	0		
Shale	0	0		
Sandstone	4	0		
Red shale	6	0		
Blue shale	2	0		
Mixed shale	13	0		
Shale	5	6		
Red shale	1	6		
Sandstone	4	0		
Sandshale	5	6		
Shale	13	6		
Red shale	4	0		
Shale and limestone	9	0		
Shale	1	0		
Limestone	2	0		

	Ft.	In.	Ft.	In.
Blue shale	2	0	207	0
Red shale	2	0		
Limestone	1	0		
Sandstone	4	0		
Red shale	1	0		
Blue shale	1	0		
Sand shale	3	6		
Red shale	4	0		
Sand shale	12	0		
Limestone	4	0		
Sand shale	1	0		
Limestone	9	0		
Limestone	5	0		
Blue shale	2	0		
Lime shale	5	0		
Limestone	6	0		
Lime shale	22	0		
Soft shale	4	0		
Coal, Sewickley			3	8
Sandstone	3′	4″		
Limestone	34	0		
Sand shale	5	0		
Blue shale	1	0		
Lime shale	2	0		
Blue shale	1	0		
Sandstone	4	0		
Blue shale	3	0		
Limestone	2	0	87	11
Dark shale	2	0		
Limestone	3	0		
Green shale	2	6		
Lime shale	5	6		
Limestone	9	0		
Soft shale	3	0		
Sand shale	1	0		
Soft shale	6	7		
Coal, Pittsburg			5	5
Total			306	0

In this well the top of the Pittsburg coal was struck at a depth of 385 feet according to W. C. Myers of Morgantown, W. Va., making it 79 feet from the top of the hole down to the Waynesburg bed.

Farther down Fish creek in Franklin district, Marshall county, Mr. J. E. Barnes put down a diamond drill boring at the mouth of Little Tribble creek, 1 mile due east of Graysville, on the E. (Nellie) Workman land (M 58), the record of which was published by Dr. I. C. White in Vol. II., page 135. The

writer published this record in connection with the Graysville section, page 91, to illustrate the general geology, and it shows the Monongahela series there to have a thickness of about 290 feet. Both the Sewickley and Redstone coals are present as well as the Pittsburg. The Waynesburg bed should crop in the hills 45 to 50 feet above the boring. Its horizon was concealed along the road where the top portion of Graysville section was measured:

Along the Ohio river front of Marshall county several diamond drill borings as well as 3 shafts have been sunk down through the Pittsburg coal and the thickness of the Monongahela series accurately determined.

A partial section of the Monongahela series measured with hand-level down the river hill just opposite the Semet-Solvay Co.'s ovens at Benwood is as follows:

Benwood Section, Marshall County.

		Thickness Ft.	Thickness In.	Total Ft.	Total In.		
1	Limestone, **Benwood**, interstratified with limy shale	30	0	30	0	33′	0″
2	**Coal, Sewickley**	3	0	33	0		
3	Limy shale	18	0	51	0		
4	Coal ..... 0′ 9″						
5	Slate, gray 0 0¼						
6	Coal ..... 0 6¼ **Redstone?**	2	3	53	3	20′	3″
7	Slate, gray. 0 0½						
8	Coal 0 11						
9	Shale	3	0	56	3		
10	**Limestone, Redstone**	29	9	86	0		
11	Shale and bluish fire clay....	10	0	96	0	48′	9″
12	Coal, Pittsburg	6	0	102	0		

The **Redstone coal** has a thickness of 2′ ″, the greatest found in the area. Its interval above the Pittsburg bed, 42′ 9″, appears excessive and it may be that it represents the lower division of the Sewickley coal which shows a tendency to split into 2 separate beds in Ohio and Marshall counties.

In the Moundsville section on page 85, the Monongahela series is shown to have a thickness of 205 feet.

On down the Ohio river at the mouth of Hog run, ½ mile

northeast of Captina (Powhatan Sta.), the Wheeling Coal and Coke Co. put down a diamond drill test on the Hammond farm (M 105), the record of which, kindly furnished the Survey, is as follows:

Hammond Core Test, Powhatan Sta., Marshall County.

(Top of hole is 621′ A. T.)		Thickness Ft.	In.	Total Ft.	In.
Surface and limestone		20	0	20	0
Limestone		25	0	45	0
Sandstone shale		14	0	59	0
Limestone		21	0	80	0
Black shale and coal mixed	3′ 0″				
Slate	1′ 0″				
Coal	1′ 0″	Pittsburg..	12	3	92	3
Fire clay	0′ 9″				
Coal	6′ 6″				

The Sewickley coal, 4 feet thick, crops in the bed of Hog run at this point, with its top coming 5 feet below the top of the core test, making the Sewickley-Pittsburg coal interval about 71 feet. The blossom of the Waynesburg bed is exposed 165 feet higher than the top of the well along the hill road leading south from this point, giving a thickness of 257 to 260 feet for the Monongahela series. This test was drilled 209 feet below the Pittsburg bed without finding any more coal.

The section given on page 89 of this report for Powhatan station shows the Monongahela to have a thickness of 262.9 feet. This section was made by joining the log of T. B. McFarland core test (M 107) along with a hand-leveled section up to the Waynesburg coal.

Another core test well was put down at Franklin station at the mouth of Coon run on the C. Higgs farm (M 109) by Mr. J. E. Barnes, the record of which was published by Dr. I. C. White in Vol. II., page 134, of the Survey reports. The log of this well was used by the writer in making the general section for Franklin Station on page 93, where the thickness of the Monongahela series is shown to be 292.9 feet, or 30 feet greater than at Powhatan Station.

In the southwest corner of Franklin district, Marshall county, Alexander Dempster put down a core test well (M 111)

on the C. P. Wells farm on the east side of the public road leading up the Ohio river, 2¼ miles northwest of Proctor, Wetzel county. This well was put down to a depth of 265 feet, and its record is as follows:

C. P. Wells Core Test, Franklin District, Marshall County.

	Thickness		Total	
	Ft.	In.	Ft.	In.
Surface (gravel etc.)	45	0	45	0
Limestone with shale partings	6	0	51	0
Limestone with shale partings	25	0	76	0
Limestone with shale partings	54	0	130	0
Limestone	27	0	157	0
Limestone	36	0	193	0
Limestone	18	0	211	0
Limestone and sandstone	30	0	241	0
Shale	17	0	258	0
Coal, Pittsburg	5	4	263	4

The tidal elevation of the top of the hole is 637 feet. The Washington coal crops 145 feet above the top of the hole, and in this region should come about 115 feet above the Waynesburg bed. The horizon of the latter seam is concealed by old terrace deposits, but evidently belongs about 30 feet above the top of the well, giving a thickness of 290 to 295 feet for the Monongahela series at this point. In this test well record the Uniontown, Sewickley and Redstone coals appear to be absent, and it is quite possible that the driller failed to take any account of these beds, since all three are present in the log of a test well (M 112) put down on the David Abersold farm, slightly less than 1 mile southwest of this point. The log of the Abersold boring was published by Dr. I. C. White in Vol. II., pages 132-33. of the State Survey reports, and was used by the writer in making up the bottom portion of the general section given for Clarington Station on page 95 of this report to which reference is here made. There the Monongahela series appears to have a thickness of 298.8 feet and the **Uniontown coal**, 9″ thick, comes 168.4 feet below the undoubted Washington coal and 233.1 feet above the Pittsburg bed. The **Sewickley** and **Redstone** coals are 2′ 4″ and 1′ 1″ in thickness, coming 84.6 and 23.6 feet respectively above the Pittsburg bed.

About 4 miles due south of Proctor, J. M. Hall of Morgantown, W. Va., and other associates, put down a diamond drill boring near the head of Coal fork of Doolin run 2⅓ miles northeast of New Martinsville, on the Ed Wagner farm (W 300) within 15 feet of a well (W 299) drilled for oil in May, 1896, on the same farm by Ed. Wagner of Wheeling, W. Va. The detailed log of the core test was kindly furnished the Survey by Mr. Hall and the driller, Mr. M. J. O'Toole. Its complete record is as follows:

Ed. Wagner Core Test, Magnolia District, Wetzel County.

	Thickness Ft.	In.	Total Ft.	In.	
(Top of hole about 880′ A. T.)					
Surface	14	0	14	0	
Sand shale	5	0	19	0	
Red shale	21	0	40	0	59′ (
Sandstone	8	0	48	0	
Green shale	11	0	59	0	
Dark shale with coal seam, Jollytown	4	0	63	0	
Green shale	7	0	70	0	
Red shale	30	0	100	0	
Sandstone, Upper Marietta	39	0	139	0	
Red shale	4	0	143	0	
Sandstone	5	0	148	0	
Red shale	3	0	151	0	153′ 6
Sandstone	8	0	159	0	
Variegated shale	29	0	188	0	
Sand shale	5	0	193	0	
Variegated shale	4	0	197	0	
Sand shale	3	0	200	0	
Dark shale	12	6	212	6	
Coal, Washington	3	0	215	6	
Fire clay	2	6	218	0	
Blue shale	6	0	224	0	
Sandstone.. }	20	0	244	0	65′ (
Green shale { **Mannington Sandstone**	21	0	265	0	
Sand shale. }	9	0	274	0	
Black shale	4	0	278	0	
Coal, Waynesburg "A"	0	8	278	8	
Fire clay	2	0	280	8	45′ 8
Lime shale	43	0	323	8	

		Thickness. Ft.	In.	Total. Ft.	In.	
Black shale, Waynesburg coal		3	0	326	8	
Lime shale		3	4	330	0	
Sandstone		4	0	334	0	
Dark shale		5	0	339	0	
Sandstone		3	0	342	0	
Sand shale		6	0	348	0	
Sandstone		6	0	354	0	101′ 2″
Lime shale		9	0	363	0	
Variegated shale		14	0	377	0	
Sand shale		11	0	388	0	
Sandstone		6	0	394	0	
Lime shale		30	1	424	1	
Dark shale		0	9	424	10	
Slate .... 0′ 4″ Coal ..... 2′ 11″ Bone ..... 0′ 0¼″ Coal ..... 0′ 8″ Bone ..... 0′ 0¾″ Coal ..... 0′ 10″	**Uniontown**	4	10	429	8	51′ 6″
Fire clay		0	8	430	4	

The writer was present when the coal, 424′ 10″ from the top of the hole, was taken out, verifying the measurement of the bed, and at the time supposed it represented the Pittsburg coal, since its structure is almost a duplicate of the latter seam in northern West Virginia. The detailed geologic study of this region since that time however, has convinced the writer it represents the **Uniontown coal** and not the **Pittsburg** bed, the latter belonging 215 to 220 feet lower in the measures or at a depth of 645 to 650 feet from the top of the well. To support this conclusion, the log of the dry hole (W 299) on the Wagner farm close by and of the same level, shows the top of the Keener sand at a depth of 1780 feet. The interval from the coal at the bottom of the Wagner core test well down to the top of the Big Injun sand then is evidently 1780 minus 430 feet, or 1350 feet. In this region the top of the Pittsburg bed belongs only about 1130 feet above the top of the Big Injun sand, this being the average interval of three wells in the vicinity; viz., John Trader No. 1 well (W 248) and J. W. O'Neil No. 1 well (W 285), both located on Proctor creek, 2½ miles to the northeast, and the Samuel W. Martin No. 1 well (W 302), located on Coal fork of Doolin, 1 mile southwest of the Ed Wagner core test well (W 300). The detailed log of the Ed Wagner No. 1 well

(W 299) near which the core test was drilled has been furnished the Survey by Mr. Edward Wagner of Wheeling, W. Va., and for the purpose of comparison with the core test in its top portion as well as to show the absence of coal seams below the Uniontown bed, it is given herewith as follows:

Ed. Wagner No. 1 Well, Magnolia District, Wetzel County.

	Thickness Feet	Total Feet
Conductor	14	14
Lime	12	26
Red rock	194	220
Coal, Washington	4	224
Lime (10″ casing 255 ft.)	30	254
Slate	45	299
Red rock	15	314
Slate	50	364
Lime	35	399
Red rock	20	419
Coal, Uniontown	9	428
Lime	50	478
Red rock	21	499
Slate	50	549
Sand rock	30	579
Lime	25	604
Slate	45	649
Slate (Pittsburg coal horizon)	12	661
Sand rock	5	666
Slate	33	699
Sand rock	25	724
Slate	75	799
Red rock	100	899
Slate	43	942
Red rock	59	1001
Slate	48	1049
Black slate	15	1064
Lime (8¼″ casing 1067′)	60	1124
Slate	54	1178
Lime (water)	66	1244
Slate	10	1254
Sand rock	30	1284
Slate	40	1324
Sand (No 6″ casing needed)	30	1354
Lime	20	1374
Black shale	18	1392
Slate	48	1440
Sand rock (supposed salt sand; no water)	120	1560
Dark slate	50	1610
Gray sand	45	1655
Shale (Pencil Cave) (did not cave enough to bother)	15	1670
Limestone, **Big Lime**	110	1780

	Thickness. Ft.	Depth. Ft.
Keener sand	40	1820
Injun sand	52	1872
Injun sand (showing of oil)	10	1882
Injun sand	22	1904
Slate and sand	6	1910
Sand and slate	10	1920
Sand and slate	35	1955
Unrecorded	395	2350
Black slate where Berea sand should be found Unrecorded to bottom of hole	21	2371

The Pittsburg coal appears to be represented only by slate. The Sewickley and Redstone beds were not noted. The thickness of the Monongahela series here is approximately 335 feet. The Doolin run section, page 99, 1 mile east of New Martinsville shows its thickness to be 320 feet.

Passing up Fishing creek from the New Martinsville region to Pine Grove at the mouth of North Fork we find a very accurate measurement of the Monongahela series from the log of the core test well (W 128) put down at this point by Hon. J. N. Camden. The record of this test was published in Vol. II., pages 136-137, of the W. Va. Geol. Survey reports by Dr. I. C. White who personally inspected the core and verified the character and thickness of the several strata given in the log as brought up by the drill. The writer published the record of this core test in connection with the general section for Pine Grove, page 103, of this report. The thickness of the Monongahela series is there shown to be 352 feet or 30 to 40 feet greater than at New Martinsville about 11 miles to the northwest. Dr. White has the following to say concerning this boring in connection with the publication of its record as referred to above:

"The **Waynesburg coal** is only six inches thick here and lies eighty feet below the bed of Fishing creek, while the **Washington coal** of the Dunkard series crops out forty-five feet above the stream, and has been mined to a small extent to supply the village. Curiously enough it contains more fuel than any member of the Monongahela series below, since even the Pittsburg coal has dwindled to only twenty six inches, the basal three inches of which is slate and bone.

"The thickness of the Monongahela rock series has increased

to near its normal, and all of its five main coals, though thin and poor, are represented at the proper horizons.

"Mr. Camden thought the Pine Grove boring had struck a 'roll' or 'fault' in the **Pittsburg coal,** and concluded to put down another test boring two miles farther down Fishing creek, near the mouth of Piney Fork, where an oil well boring had reported six feet of Pittsburg coal. The boring was located only a few feet distant from the oil well, but when the Pittsburg coal was struck the core barrel brought up only twenty-four inches of coal and thirty-six inches of black slate. The records of these two borings constitute the data for drawing the productive outcrop of the Pittsburg coal to the east of Pine Grove."

The last boring referred to here by Dr. White is the F. C. Headley core test well (W 231), located on the north side of the public road leading down Fish creek at the mouth of Shenango run and on the east edge of the road leading down the latter stream. The writer was unable to obtain the record of this well. The elevation of the top of this boring is 694 feet A. T., and the same for the base of the Washington coal, exposed on the south side of Fishing creek just opposite, is 718 feet A. T. spirit level measurement. The rocks rise rapidly up Shenango run on the east flank of the Big Moses anticline and less than a mile up the stream from the latter boring (W 231) the Washington coal has risen from 718′ A. T. to 740′ A. T. Two miles up Shenango Mr. S. W. Meals of Moundsville, W. Va., put down a test well (W 228) on the Brown farm near the summit of the Big Moses anticline. The record of this well was kindly furnished the Survey by Mr. Meals and published by the writer on page 153 of this report in connection with Brown P. O. section of the Dunkard series. There the complete record of the test as furnished by Mr. Meals is given by formations Nos. 17 to 26 inclusive. The elevation of the top of the well here is about 905′ A. T. The elevation of the coal identified by the writer as the Washington, 130 feet from the top of the boring and 695 feet from the top of the section, is 905′ A. T.—132 feet, or 773′ A. T., giving a total rise in the rocks from the mouth of Shenango creek of 55 feet. According

to Mr. Meals the Brown test well was drilled to a depth of only 530 feet, and the Pittsburg coal should come there at a depth of 580 to 590 feet from the top of the hole, or about 250 feet below the Uniontown coal, the interval of the latter bed above the Pittsburg seam in three core test wells; viz., at Pine Grove (W 128), 1 mile southeast of Jacksonburg (W 177) and at Mobley (W 150). The Brown well (W 228) was put down with a "churn drill" and no core was taken out, but care was taken to keep an accurate log of all coal beds. The Uniontown coal here has a thickness of 4 feet and is apparently the most important coal of the section. This is true also in the core test well (W 177) put down one mile southeast of Jacksonburg by the Fairmont Coal Co. on the M. V. Anderson farm where the thickness of the Monongehela series is 361 feet, or 11 feet greater than at Pine Grove. The Fairmont Coal Co. kindly furnished the Survey the folowing accurate log of this boring, omitting the thickness of the Pittsburg coal, as well as the log of the core test well (W 150) at Mobley, Wetzel county:

M. V. Anderson Core Test Well, (W 177) Located on North Bank of Fishing Creek, 1 Mile Southeast of Jacksonburg, Wetzel County, by Fairmont Coal Co.

Tidal elevation of top=762.72'

	Thickness		Total	
	Ft.	In.	Ft.	In.
Surface	11	0	11	0
Sandy shale	8	0	19	0
Slaty fire clay	10	3	29	3
Coal and slate, Washington	2	0	31	3
Dark slate	5	5	36	8
Fire clay	12	0	48	8
Sandy shale	5	7	54	3
Fire clay and streaks of lime	6	0	60	3
Blue shale	5	5	65	8
Sandstone	3	3	68	11
Blue shale	4	0	72	11
Gray sand	7	7	80	6
Dark slate	16	0	96	6
Sandy shale	2	10	99	4
Fire clay	2	0	101	4
Coal, Waynesburg "A"	0	4	101	8
Fire clay	12	0	113	8
Red fire clay	4	8	118	4
Sandstone, Waynesburg	40	8	159	0

	Thickness Ft.	In.	Total. Ft.	In.
Dark slate	5	2	164	2
Coal, Waynesburg	0	10	165	0
Fire clay	1	0	166	0
Shale and streaks of sand	47	8	213	8
Red fire clay	4	6	218	2
Sandstone	7	9	225	11
Fire clay	4	0	229	11
Red shale	21	3	251	2
Blue shale	19	2	270	4
Coal, Uniontown	2	5	272	9
Slaty fire clay	4	8	277	5
Sandstone	4	6	281	11
Blue shale	13	3	295	2
Limestone	3	5	298	7
Dark shale	5	3	303	10
Limestone	28	5	332	3
Red fire clay	7	8	339	11
Blue shale	8	9	348	8
Limestone	41	0	389	8
Dark slate	6	0	395	8
Limestone	10	8	406	4
Fire clay	3	0	409	4
Coal and slate, Sewickley	1	10	411	2
Gray shale	18	7	429	9
Limestone	12	4	442	1
Light shale	12	8	454	9
Limestone	13	0	467	9
Light shale	17	4	485	1
Limestone	4	0	489	1
Fire clay	3	6	492	7
Black shale, Redstone coal horizon	2	6	495	1
Fire clay	1	2	496	3
Limestone	16	5	512	8
Dark shale	1	3	513	11
Limestone and fire clay	8	5	522	4
Fire clay	0	9	523	1
Pittsburg coal, top of				

The log of this boring is very important in that it reveals the thickness and character of the main coal beds of the Dunkard and Monongahela series with the exception of the Pittsburg bed the thickness of which was purposely omitted from the record furnished the Survey. It is readily observed that the **Washington** and **Uniontown** coals are the most important from an economic standpoint in the section; the **Waynesburg "A" Waynesburg, Sewickley** and **Redstone coals** have become thin and unimportant in this portion of Wetzel county. This state of affairs exists on southwest of Jacksonburg in Tyler county. The record of the other core test well on the Jas. Shuman farm

at Mobley P. O., 4 to 5 miles northeast of the M. V. Anderson boring, is as follows:

James Shuman Core Test Well, (W 150) Located on North Fork of Fishing Creek, at Mobley P. O., Wetzel County, by Fairmont Coal Co.

Tidal elevation of top=871.39'	Thicknss Ft.	In.	Total Ft.	In.
Surface	22	0	22	0
Soft fire clay	13	0	35	0
Red fire clay	6	8	41	8
Gray shale	17	6	59	2
Sandstone	8	8	67	10
Light shale	22	0	89	10
Fire clay	13	5	103	3
Black slate, streaks of coal 8 8 / Sandy shale 2 0 / Soft slate 4 1 / **Coal** 0 8 — **Washington Coal**	15	5	118	8
Fire clay	8	8	127	4
Sandy shale	23	0	150	4
Red fire clay	3	7	153	11
Light shale	28	9	182	8
Fire clay	1	8	184	4
Coal, Waynesburg "A"	0	3	184	7
Fire clay	7	0	191	7
Red fire clay	7	0	198	7
Sandstone, Waynesburg	49	0	247	7
Shale	1	0	248	7
Coal, Waynesburg	1	0	249	7
Gray shale	14	0	263	7
Sandstone, Gilboy	10	6	274	1
Gray shale	16	6	290	7
Sandstone, Uniontown	59	9	350	4
Coal and slate, Uniontown	2	0	352	4
Sandy shale	4	0	356	4
Fire clay	12	0	368	4
Sandstone	10	0	378	4
Blue shale	11	0	389	4
Limestone	9	0	398	4
Fire clay	11	0	409	4
Limestone	7	0	416	4
Green shale	7	0	423	4
Sandstone, Sewickley	15	0	438	4
Limestone, **Benwood**	38	6	476	10
Fire clay, streaks of lime	17	0	493	10
Limestone	8	6	502	4
Slate	2	10	505	2
Coal, Sewickley	1	6	506	8
Fire clay	6	0	512	8

	Thickness.		Total.	
	Ft.	In.	Ft.	In.
Limestone	4	0	516	8
Slaty fire clay	12	0	528	8
Black slate	10	3	538	11
Limestone	23	0	561	11
Fire clay	4	0	565	11
Limestone	4	0	569	11
Fire clay, streaks of lime	17	5	587	4
Limestone	8	0	595	4
Fire clay	6	0	601	4
Dark slate	1	8	603	0
Pittsburg coal, top of				

This is another very important boring in that it reveals no coal of commercial thickness and purity above the Pittsburg bed in this portion of Wetzel county. The **Washington, Waynesburg "A", Waynesburg, Uniontown, and Sewickley coals** have all become thin and unimportant. The thickness of the **Pittsburg bed** was purposely omitted from the log furnished the Survey, but according to indirect information obtained by the writer there was a good thickness, 7 to 8 feet, of Pittsburg coal in this boring. The several oil and gas well records in this vicinity report a good thickness of Pittsburg coal. The change in character of the latter bed must take place about 4 miles to the west of Mobley, where it apparently is replaced in part by slate, thinning down to even less than 2 feet of impure coal.

In the general section given for Owlshead Knob, Jacksonburg, on page 107 of this report, the intervals there shown between the Waynesburg "A", Waynesburg, Uniontown, Upper Sewickley and Pittsburg coals are those taken from the core test well (W 177). The thickness of the coals are there omitted except in the case of the Pittsburg bed. The latter is there given as 8 feet thick, the figure called for in the log of the G. W. T. Anderson well No. 4 (W 175). Oil well records, however, are unreliable, since a Mr. Zinn of West Union, W. Va., once put down a diamond drill boring (W 174) close by this well and found only 2 feet of impure coal at the horizon of the Pittsburg bed. Mr. James Ribb, foreman for the Carter Oil Co., (the latter furnishing the natural gas for the drilling of the test on the M. V. Anderson farm, or W. 177 on map) informed the

writer that he was present when the core for the Pittsburg coal was taken out at the latter test and that the coal was quite thin. From the logs of thse two core tests, (W 174) and (W 177), and the Camden boring (W. 128) at Pine Grove, it would seem that the western margin of the Pittsburg coal bed, when of commercial purity and thickness, lies about 2 miles east of Jacksonburg.

In the core test well at Mobley (W. 150) the thickness of the Monongahela series is the same as at Jacksonburg; viz., 361 feet, and the intervals between the same coals as in the Jacksonburg boring (W 177), are nearly the same, varying only a few feet. The thickness of the Pittsburg coal, however, was omitted from the log, but the writer obtained indirect information that this bed was 7 feet thick in this test and of good quality. In this region all the oil wells report a good thickness of the Pittsburg bed.

In the southeastern corner of Grant district, Wetzel county, the log of the Blackshere, Wells & Co., No. 5 well (W 198) located on Arches fork, ⅓ mile southeast of Arches P. O gives the greatest thickness (375 feet) for the Monongahela series observed in the 3 counties. The record of this well is pubished in connection with the section for Arches fork on page 108 of this report. In the vicinity of Wileyville, 12 miles northwest of Arches P. O., the thickness of the Monongahela series is 315 feet as revealed by oil wells in that vicinity. The record of the Ira Jolliffe No. 1 well (W 70), located 5½ miles northeast of Wileyville on Mudlick run of Carney fork, Center district, Wetzel county is very important in that it shows 3 coals in the Dunkard series in addition to 3 coals for the Monongahela. This well was drilled by the South Penn Oil Co., which kindly furnished the Survey the following record:

Ira Jolliffe No. 1 Well (W 70), Center District, Wetzel County.

(Elevation = 1125' A. T.)

	Thickness. Ft.	Total. Ft.
Unrecorded from top of hole	425	425
Coal, Jollytown	2	427
Unrecorded	138	565
Coal, Washington	2	567

	Thickness Ft.	Total Ft.
Unrecorded	73	640
Coal, Waynesburg "A"	6	646
Unrecorded	58	704
Coal, Waynesburg	2	706
Unrecorded	229	935
Coal, Sewickley	4	939
Unrecorded	86	1025
Coal, Pittsburg	5	1030
Unrecorded	320	1350
Little Dunkard Sand and shells	180	1530
Big Dunkard Sand	65	1595
Unrecorded	195	1790
Salt Sand	155	1945
Unrecorded	125	2070
Maxton Sand	90	2160
Unrecorded	20	2180
Big Lime, Greenbrier Limestone	50	2230
Big Injun Sand	240	2470
Unrecorded	584	3054
Gordon Sand	21	3075
Unrecorded to bottom	165	3240

The Monongahela series extends here from 704 feet down to 1030 feet, giving it a thickness of 326 feet. According to this well record the **Waynesburg "A" Coal** belonging in the Dunkard series is thicker than any of the Monongahela coals. The records of oil and gas wells, however. are unreliable as to exact thickness and quality of the coal beds encountered.

In Church district in the northeast portion of Wetzel county, the log of the Sarah Anderson No. 1 well (W 1) which was used by the writer in making up the general section for Burton, page 110 of this report, the thickness of the Monongahela series is 362 feet. The Waynesburg, Upper Sewickley and Pittsburg coals are all present in good development, having a thickness of 5, 8, and 8 feet respectively, according to the driller's log.

In Tyler county both the Waynesburg and Pittsburg coals appear to be absent entirely over most of its area and for this reason it has sometimes been a difficult matter to determine definitely the limits of the Monongahela series. In the section measured down the river hill, 1 mile northeast of Sistersville, page 120, it is shown to have a thickness of 322 feet. There the Uniontown coal appears to be badly split up, while the Pitts-

appearing to be absent entirely, or represented only by black slate.

In the section given for Middlebourne on page 117, the thickness of the Monongahela series is put at 353 feet.

In the section given for the southern part of Tyler county at McKim P. O., page 118, its thickness is approximated there at 335 feet.

In the eastern part of Tyler, the section given for Big Moses, page 116, shows this series to have a thickness of 354 feet. In this county the coals of the Monongahela series have become thin and unimportant from an economic standpoint, not even excepting the Pittsburg bed. Its limestones have nearly all disappeared, or been replaced by red, limy shales or sandy beds.

DESCRIPTION OF THE MONONGAHELA FORMATIONS.

The following formations are included in the Monongahela series in the Marshall-Wetzel-Tyler county area:

Waynesburg Coal.
Little Waynesburg Coal.
Waynesburg Limestone.
Gilboy Sandstone.
Uniontown Sandstone.
Uniontown Coal.
Uniontown Limestone.
Fulton Green Shale.
Benwood Limestone.
Sewickley Sandstone.
Upper Sewickley Coal.
Lower Sewickley Coal.
Sewickley Limestone.
Redstone Coal.
Upper Pittsburg Sandstone.
Pittsburg Coal.

The Waynesburg Coal.

The Waynesburg coal is the highest member of the Monongahela series, and received its name from Waynesburg, the county seat of Greene Co., Pa., near which place it has been

mined for years. It was Number 11 seam in the former coal nomenclature of Ohio. In Vol. II., page 147, of the W. Va. Geol. Survey reports, Dr. I. C. White has the following to say concerning this bed:

"The seam is always multiple bedded, being generally separated into a 'roof', 'upper' and 'lower' divisions by shale and fire clay partings, the whole often nine to ten feet in thickness. This coal appears to attain its maximum thickness and importance in Marion and Monongalia counties, and the adjoining region of Greene county, Pennsylvania, since it thins down in every direction when traced away from these regions.

"The coal is always high in ash and moisture, and hence is a poor steam coal, and is used for that purpose only when nothing better is accessible. Of course there is always some good coal in the bed, but it is generally mixed up with the poorer quality in mining and the resultant fuel is never of first-class grade.

"The following section of this coal at David L. Myers' mine on Scotts run, Cass district, Monongalia county, made by Mr. John M. Gregg, will reveal the usual structure of the coal when thick:

			Ft.	In.
Coal	4′	5″		
Impure fire clay	0′	8″	9	2
Coal	4′	3″		

"Mr. Gregg collected a sample of this coal entirely across the bed for analysis. It yielded the following results to Prof. B. H. Hite, Chemist for the Survey:

Moisture	1.69
Volatile matter	30.04
Fixed carbon	44.93
Ash	23.34
	100.00
Sulphur	1.98
Phosphorus	0.012

"Some of the mines will probably yield a coal lower in ash than this, but none will run much under fifteen per cent. as an

average for the whole bed. The lower half of the seam has usually less ash and sulphur than the upper. The 'roof' coal is not shown in this section, but it is generally present at one to three feet above the upper bench from which it is separated by a gray shale full of fossil plants and insects in the region of Cassville, Monongalia county."

This coal has been the main source of supply for local domestic fuel in northern Greene county, Pa., along Wheeling and Tenmile creeks and can be traced in all directions from this area. It corresponds to the Koontz vein of Maryland where it has the following structure:[2]

	Ft.	In.
Coal	2	3
Bone	0	4
Coal	0	6
Bone	0	7
Coal	1	3
Slate	0	10
Coal	0	5
Shale	0	0
Total	6	2

In the Marshall-Wetzel-Tyler area the crop of this bed is exposed only along Wheeling creek and the Ohio river front, extending up some distance from the latter stream before passing below drainage on Grave and Fish creeks. It appears to thin away southwestward from the northern part of the area under discussion and where its horizon is exposed in Wetzel and Tyler counties, it seems to be represented only by a few inches of slaty coal or bituminous shale of no economic importance.

In the northern portion of Marshall county, however, it has been mined by the farmers along Wheeling creek for local domestic fuel, of which it furnishes a fair grade. A section of this bed at the mine of J. M. Allison, opposite the mouth of Dunkard fork of Wheeling creek, 1 mile below Majorsville shows as follows descending:

2 Md. Geol. Survey. Alleghany County Report, p. 180.

		Ft.	In.
1	Coal, fair	1	6
2	Shaly fire clay	1	0
3	Coal	0	9
4	Shaly fire clay	0	1
5	Coal, fair	1	7
	Total	4	11

Farther down Wheeling creek the John Sheppard opening on Burches run, a short distance up from its mouth, gives the following section for this coal:

		Ft.	In.
1	Coal	1	6
2	Slate, gray	0	9
3	Coal	0	5 ½
4	Slate	0	0 ½
5	Coal	1	0
	Total	3	9

The slate. No. 2 of section, is very persistent wherever exposed along this creek.

The following section was measured where this coal crops along the Ohio river front of Marshall county on Koon run at McMechen:

		Ft.	In.
1	Limestone dark, flaggy, Elm Grove	5	0
2	Shale, gray and limy	2	6
3	Slate, black, coaly 0′ 6″		
4	Gray shale 0′ 10″	3	2
5	Coal, blocky and hard 1′ 10″		
6	Fire clay.		

It crops along the road leading south up the hill from the mouth of Grave creek at Moundsville and there has the following section.

		Ft.	In.
1	Coal	0	2
2	Slate	0	1
3	Coal	1	8
	Total	1	11

In the general section measured at Powhatan station, page 89, this bed is shown to have the following structure:

		Feet
1	Shale, black	0.4
2	Coal	0.3
	Total	0.7

The above sections tend to show how this bed appears to thin out southwestward and with the possible exception of the section measured down the river hill at Sistersville, page 120, it was not recognized in Tyler county.

The composition, character, and distribution of this coal in northern Marshall will be taken up in the chapter on Coal Resources of the area. Its outcrop has been placed on the economic geology map accompanying this report.

The Little Waynesburg Coal.

At 10 to 20 feet below the Waynesburg bed in Pennsylvania there often occurs a thin coal 6 to 12 inches thick that has been named the **Little Waynesburg coal** by Dr. J. J. Stevenson. It never attains minable thickness and is of no economic importance. It was not identified at any point by the writer in the Marshall-Wetzel-Tyler area.

The Waynesburg Limestone.

At 25 to 40 feet below the Waynesburg coal, coming directly under the Little Waynesburg coal, there occurs a limestone of wide distribution that has been named the **Waynesburg limestone**. Dr. I. C. White[3] has the following to say concerning this stratum:

"It is usually of a dark gray color, and several of the layers make excellent lime for agricultural purposes. The thickness in Pennsylvania and northern West Virginia is seldom less than 8 feet, and frequently double that, but southwestward,

3. Bulletin No. 65, page 58, U. S. G. Survey.

toward the Great Kanawha region, the limestone disappears entirely."

This limestone was identified at only one point in the 3 counties by the writer. This place was near the mouth of Burches run of Wheeling creek in Marshall county, just below the Jno. Sheppard opening in the Waynesburg coal where the following section is exposed:

		Ft.	In.
1	**Coal, Waynesburg,** with partings	3	9
2	Concealed and shale	8	0
3	Sandstone, massive and cross bedded	15	0
4	Shale	5	0
5	**Limestone, Waynesburg to creek level**	2	0

The detailed log of the J. T. Cox No. 1 well (M 24) on Wolf run of Wheeling creek, Marshall county, calls for 15 feet of **limestone** coming 14 feet below the Waynesburg coal, that most likely represents the Waynesburg limestone. This stratum was not reported in the many core tests drilled in Marshall and Wetzel counties down through the entire Monongahela series.

The Gilboy Sandstone.

At 5 to 10 feet below the Waynesburg coal there often occurs a massive rock that has been designated the **Gilboy sandstone** by Dr. I. C. White.[4] He has the following to say concerning this stratum:

"Very frequently, and especially along the eastern crop of the Waynesburg coal, a great sandstone mass comes into the section at five to ten feet below that coal, cutting out the Little Waynesburg coal and its underlying limestone completely. This stratum is very prominent in what is known as 'Gilboy' cut on the B. & O. R. R., just east from Mannington, and has been designated from that locality. It was formerly termed the Browntown sandstone from a locality in Harrison county, where it is very massive, but as there is a **Brownstown sandstone** in Kanawha county it was concluded best to change the name of this one to Gilboy.

4. Vol. II, page 150, W. Va., Geol. Survey.

"The stratum in question is a very hard, rather fine-grained, grayish white rock, seldom containing any pebbles, and when present forms a bold cliff or bluff below that of the Waynesburg pebbly sandstone above. It is especially prominent in Marion, Lewis and Gilmer counties.

"The stratum does not appear to be very massive or thick in northern Marshall county, but thickens up southwest along the Ohio river front, and in the section made at Franklin Sta., page 93, is 25 feet thick and quite massive, coming 10 feet below the blossom of the Waynesburg coal. At Pine Grove the record of the Camden boring (W 128) shows it to be 32 feet thick, coming 11 feet below the Waynesburg coal, and 52 feet above the Uniontown bed. In the Jacksonburg boring (W 177) its horizon is represented by alternate layers of sandstone and shale. In the Mobley, Wetzel county, core test well (W 150), it is only 10½ feet thick coming 14 feet below the Waynesburg coal, and 16½ feet above the Uniontown sandstone.

In the section at Burton, Church district, Wetzel county, page 153, it is shown to be 34 feet thick, coming 35 feet below the Waynesburg coal.

It appears to be this stratum that is quarried at Sistersville, Tyler county, along the turnpike leading to Middlebourne. At this point it is 50 feet thick, its base coming only 20 feet above the Uniontown coal, and 105 feet below the Waynesburg "A" bed, cropping at the watering trough. This sandstone forms very steep bluffs along the river hills on southwest to Bens Run station. It appears to be the prominent cliff rock on the Ohio side of the river opposite Sistersville. It was not observed away from the Ohio river front in Tyler county.

The Uniontown Sandstone.

Another very massive sandstone often comes into the measures a few feet below the Gilboy sandstone and immediately overlying the **Uniontown coal**. It has been designated the **Uniontown sandstone** by Dr. I. C. White. In Bulletin 65, (pp. 58, 59), U. S. G. Survey, he has the following to say concerning this stratum:

"At 60 to 75 feet below the top of the series[5] there frequently occurs a massive, gray sandstone whose horizon comes immediately above the Uniontown coal; and hence, although the stratum in question is not prominent at Uniontown, it has been designated from its relations to the underlying coal.

"The rock has occasionally been mistaken for the Waynesburg sandstone, which belongs nearly 100 feet above. It is well exposed at Bobtown, Greene county, Pennsylvania, where it crowns the summit of the hill overlooking Dunkard creek as a bold cliff."

It is probably the "shallow oil sand" of Ritchie county, operated on the Carroll farm by the Clark Oil Co. at Cairo, the highest known oil sand geologically in the state.

In the core test well (W 150) at Mobley P. O., Wetzel county, this stratum immediately overlies the Uniontown coal and is a great sandstone 59¾ feet in thickness. At the Jacksonburg boring (W 177) its horizon is represented by sandstone and red and blue shales. At Sistersville, Tyler county, it appears to be represented by much red shale and sandy beds.

The Uniontown Coal.

From 75 to 125 feet below the Waynesburg coal there comes a fairly persistent bed that has been named by the First Geol. Survey of Pennsylvania the Uniontown coal from its occurrence near the town of that name in Pennsylvania. According to Dr. I. C. White (Vol. II., page 150, W. Va. Geol. Survey). "It is seldom more than three feet thick, often only two, and sometimes represented merely by **black slate."**

In central and western Wetzel county this coal appears to reach its best development as revealed by several diamond drill borings. A fine section of this bed is obtained from the Ed Wagner core test well (W 300) record on Coal fork of Doolin run, 2½ miles northeast of New Martinsville, published on page 271 of this report. There the following structure is exhibited:

5. Referring to the Monongahela Series.

				Ft.	In.
1	Slate, black			0	4
2	Coal	2′ 11″			
3	Bone	0′ 0 ¼″			
4	Coal	0′ 8″	Uniontown	4	6
5	Bone	0′ 0 ½″			
6	Coal	0′ 10 ¼″			
7	Fire clay.				

At the time this well was drilled, during July, 1906, this coal struck at a depth of 424′ 8″, was supposed to represent the Pittsburg bed. The drillers of the test well, J. M. Hall of Morgantown and other associates, notified the writer whom they wished to be present when the coal was taken out to verify its measurement, that they had reached the Pittsburg bed and were ready to take out the coal. For reasons already given on page 272, in connection with the core test record, the writer is convinced that this coal represents the **Uniontown bed** and not the **Pittsburg seam,** and that the test did not reach the Pittsburg horizon by 215 to 220 feet. The chemical analysis of the Uniontown coal from this core test reveals a high grade fuel, the same being published by Dr. I. C. White in Vol. II., (a), pp. 659-660, and 668, as representing the Pittsburg bed as follows:

Proximate Analysis.

	Per cent.
Moisture	1.68
Volatile matter	37.07
Fixed carbon	53.07
Ash	8.18
Total	100.00

Ultimate Analysis.

	Per cent.
Carbon	77.82
Hydrogen	4.11
Oxygen	4.67
Nitrogen	1.02
Sulphur	4.20
Ash	8.18
Total	100.00

	Per Cent.
Sulphur	4.20
Phosphorus	0.003
Calorific value:	
Calorimeter B. T. U.	13,739
Calculated B. T. U.	13.648

In calorific value it is 200 to 300 British thermal units higher than the average of several samples of Pittsburg coal from the Benwood, W. Va., region. This result is no doubt due to a slightly higher percentage of total carbon, and a much lower

per cent. of oxygen, the latter being only about ½ that of the Pittsburg bed for the region above mentioned.

Its horizon was also noted at a depth of 180 feet in the Samuel Martin No. 1 well (W 302) farther down Coal fork of Doolin, (See Doolin run section, page 99) coming 250 feet above the Pittsburg bed.

In the Pine Grove boring (W 128) published on page 103 in connection with section at that place, the Uniontown coal is 1′ 6″ thick, coming 96 feet below the Waynesburg bed and 251 feet above the Pittsburg bed.

In the core test on the Anderson farm (W177). 1 mile southeast of Jacksonburg, the Uniontown coal is 2′ 5″ thick, coming 105 feet below the Waynesburg bed, and 250 feet above the Pittsburg seam. Here it appears to be the best coal in the Monongahela series.

In the Mobley, Wetzel county, core test well (W 150), located 4¾ miles N. 60° E. from the Jacksonburg boring (W 177), the Uniontown coal is represented by 2 feet of coal and slate, coming 100 feet below the Waynesburg vein and 250 feet above the Pittsburg bed. Its horizon was not recognized at any other point in Wetzel county.

Along the Ohio river front of Marshall county the writer made many sections where the horizon of this coal crops above drainage, but failed to recognize the same. The Anderson core test well (M 95) on Whetstone run, 2 miles south of Meighen P. O., the log of which is published on page 266, fails to report the presence of this coal. The David Abersold core test well (M 112) in the southwest corner of Marshall county, however, page 96, reports the Uniontown coal 9 inches thick, coming 233 feet above the Pitttsburg bed as against 250 feet for the same interval in the Samuel Martin No. 1 well (W 302) 1 mile east of New Martinsville.

In Tyler county it appears to be this coal that crops along the electric car line leading from New Martinsville to Sistersville, 1 mile above the latter place. The following section was measured at its outcrop at this point:

1	Coal	0′ 2″			
2	Shale, gray and soft	2′ 7″			
3	Coaly streak	0′ 3″	**Uniontown**	8	0
4	Shale, gray	3			
5	Coal, with limy, dark fossiliferous slate	2′ 0″			

Its relation to other strata there is readily observed by referring to the Sistersville section on page 120 of this report. The log of the J. T. Leasure No. 3 well (T 14A), used by the writer in making up this section, reports the Uniontown coal 5 feet thick at a depth of 335 feet, coming 228 feet above the Pittsburg bed also noted in well record. At Sistersville the Uniontown coal comes 15 to 25 feet above a limestone series, 20 to 25 feet thick, interstratified with red shales and sandy beds. The J. B. McCoy No. 15 well (T 18A) used by the writer in making up the Sistersville turnpike section, page 121, reports the Uniontown coal 3 feet thick at a depth of 100 feet, coming 1417 feet above the top of the Keener sand.

Farther down the Ohio river front of Tyler the writer obtained another section of the Uniontown bed from its outcrop on the east side of the public road, ½ mile southwest of Friendly as follows:

				Ft.	In.
1	Sandstone, friable			10	0
2	Sandy shale			5	0
3	Slate, black	1′ 0″			
4	Shale, gray	0 3	**Uniontown**	1	9
5	Coal	0 6			
6	Fire clay and concealed			25	0
7	**Limestone Series.**				

Its tidal elevation here is about 710 feet, coming about 125 feet above low water in the Ohio river, and 150 feet below another coal cropping in the hill above that the writer has identified as the Waynesburg "A" bed.

Passing into the interior of Tyler county the Uniontown coal is called for in many of the oil well records of the Wick and McKim oil fields, and often erroneously taken by the driller to represent the Pittsburg bed. The detailed log of the Moses Johnson No. 1 well (T 229), located 1 mile northwest of McKim P. O., used by the writer in making up the section for the latter place on page 118, shows the Uniontown coal in this portion of Tyler

to have a total section, including its accompanying black slate, of 8 feet, coming 187 feet below the Washington coal, 249 feet above the Pittsburg bed and 1466 feet above the top of the Keener sand, the latter interval being 49 feet greater than at Sistersville, 11½ miles to the northwest. Two miles northwest of Wick P. O. the Uniontown coal is reported in the B. F. Robinson No. 1 well (T 253) 3 feet thick at a depth of 362 feet, coming 1435 feet above the top of the Big Injun sand. No. 2 well (T 254) on the same farm reports 3 feet of Pittsburg coal, coming only 1234 feet above the top of the Big Injun sand. Its relation to the oil sands is well illustrated by the log of the Peter Stewart No. 1 well (T 242), located 2 miles southeast of McKim P. O., on the head of Lizzies Roost run in the edge of Ritchie county. This record is as follows:

Peter Stewart No. 1 Well (T 242), 2 Miles S. E. of McKim.

	Thickness Feet	Total Feet
Unrecorded	400	400
Coal, Uniontown	3	403
Unrecorded	487	890
1st Cow Run Sand (Saltsburg)	20	910
Unrecorded	95	1005
2nd Cow Run Sand? (Dunkard) (Mahoning)	15	1020
Unrecorded	230	1250
Salt Sand	90	1340
Unrecorded	80	1420
Salt Sand (water at 1530')	110	1530
Unrecorded	150	1680
Maxton Sand	30	1710
Unrecorded	119	1829
Cave	6	1835
Big Lime, Greenbrier Limestone	70	1905
Keener Sand	15	1920
Big Injun Sand	120	2040
Gas at 2007, oil at 2019.		
Unrecorded to bottom	59	2099

In this well the Uniontown coal comes 1502 feet above the top of the Keener sand and 617 feet above a sand that has been erroneously called the Cow Run, since the Pittsburg coal, if present, should come at a depth of about 650 feet or about 250 feet below the Uniontown coal and 1250 to 1260 above the

Keener sand, allowing for the increase in thickness of the measures to the southeast. The log of the K. S. Boreman No. 2 well (T 103), located on a branch of Gorrell run, 1 mile east of Middlebourne, shows the Uniontown coal to be 5 feet thick, at a depth of 260 feet, coming 1489 feet above the top of the Keener sand, and 195 feet below the Washington coal. This bed was not definitely recognized in any of the well records of eastern Tyler county.

The Uniontown coal in commercial thickness (18 inches to 5 feet) and purity, need hardly be considered in the eastern half of the Marshall-Wetzel-Tyler area in calculating its coal resources, but Magnolia district, Wetzel, and Lincoln, Union, Ellsworth and Meade districts, Tyler county, may eventually produce quite a large acreage of this bed. Where it attains its best development, it is quite a fine coal as is well evidenced by its chemical analysis given above from the Ed Wagner core test.

The Uniontown Limestone.

The limestone coming in the interval between the Uniontown and Sewickley coals was named the **Great Limestone** by the First Geol. Survey of Pennsylvania. Later it was divided by Prof. J. J. Stevenson into two divisions: the **Upper** 6 to 18 feet thick, has a bright buff color, coming immediately under the Uniontown coal, and has been designated the **Uniontown limestone** from its relation to the coal; the **Lower** division, 60 to 90 feet thick is quite variable in character. Prof. J. J. Stevenson gives the following description of the Lower division of the Great Limestone in Pennsylvania.[6]

"The lower portion is commonly more or less magnesian, breaks with a smooth surface which is sometimes lustreless, while at others it is quite bright. This part is employed for the manufacture of cement at many places, and is available throughout eastern Washington county. It is the more persistent part of the mass, having been identified in Allegheny county on the Pittsburg and Steubenville pike. When exposed to the weather it eventually breaks up into small angular fragments. Its thick-

6. 2nd Geol. Survey of Pa., Report K, p. 64.

ness is sometimes fully 50 feet, nearly all of which is limestone. The relative proportion of shale increases northward, and in Allegheny county the shale seems to predominate. This portion is wholly non-fossiliferous except in a thin layer at the base. The upper portion contains every variety of limestone, from that pure enough for the manufacture of lime, to that which is utterly worthless for any purpose whatever."

In his Ohio-Brooke-Hancock county report of the State Survey, page 91, Prof. G. P. Grimsley makes the **Fulton Green shale** the dvision line between the Upper and Lower portions of the Great Limestone. There he has the following to say:

"Dr. I. C. White has named the Lower division of the Great Limestone, the Benwood, from Benwood, West Virginia, where there are excellent exposures of the rock; and limits the name Uniontown to the Upper division.

"In the Ohio county area, where the Uniontown coal is absent, there is found a very persistent bed of green shale at a horizon 80 to 100 feet below the Waynesburg coal, and 80 to 90 feet above the Sewickley. There is a marked contrast in the limestone above and below this shale, but the characters of the rock agree closely with those given by Stevenson for the Lower and Upper divisions of the Great Limestone in Pennsylvania. In the present report this green shale is taken as the dividing horizon between the Upper or Uniontown limestone, and the Lower, or Benwood.

"The limestone above the green shale is a hard, blue rock, one to two feet thick, resting directly on the green shale or a short distance above. Then comes a series of sandy lime layers buff to brown in color, and shaly. These calcareous shales finally pass into typical buff shales with thin sandstone layers and in places thin limestone strata. Their thickness varies from 20 to 50 feet. In the Ohio county area it is difficult to determine accurately the upper limit of the Uniontown limestone with its calcareous shales. Where the Uniontown coal or black slate is present this limestone would extend to that horizon.

"The structure of the Uniontown limestone in this area is well exposed in the B. & O. railroad cut at Roney's Point, which shows:

	Feet
Shales sandy from top of hill	12
Nodular limestone	2
Calcareous sandy shales	10
Limestone	2
Shales, buff	10
Limestone	2
Shales, buff	6
Limestone	2
	46

In the Marshall-Wetzel-Tyler area, the horizon of the Uniontown coal where it outcrops along the Ohio river front is very indefinite, since no coal has been observed at this horizon until Sistersville is reached in passing down the river. At the latter place a limestone series that may represent the Uniontown limestone comes into the measures 15 to 25 feet below what the writer has identified as the Uniontown coal. This series of limestones is made up of alternate layers of hard gray limestone, red beds and sandy shale, having a total thickness of 20 to 25 feet. In the David Abersold boring (M 112) in the southwest corner of Marshall county, this same limestone series sets in 30 feet below the Uniotown coal.

In the core test well (W 150) at Mobley, Wetzel county, this limestone is separated into 2 layers by 11 feet of fire clay The upper layer is 9 feet thick, coming 37 feet below the Uniontown coal. The lower layer is 7 feet thick, coming immediately over 7 feet of green shale (Fulton).

In the core test well (W 177) located 1 mile southeast of Jacksonburg, the Uniontown limestone is split into 2 layers by 5′ 3″ of dark shale. The upper layer is 3′ 5″ thick, coming 22 feet below the Uniontown coal. The lower layer is 28′ 5″ thick, coming 16′ 5″ above the top of the Benwood limestone.

At Bens Run Sta., Tyler county, it appears to be this limestone cropping at the forks of the road near the mouth of the stream of that name.

The Fulton Green Shale.

Immediately under the Uniontown limestone there often occurs a bright green, finely laminated shale that has been desig-

nated the **Fulton Green Shale** by Prof. G. P. Grimsley[7] from its exposure at the town of Fulton, Ohio Co., W. Va. His original description is as follows:

"The stratum of green shale 80 to 90 feet above the Sewickley coal, is very persistent through Ohio county and is especially well developed in the Wheeling area, where it is 2½ to 5 feet thick. Its geological horizon is clearly shown in the Fulton section, and the name Fulton Green Shale is therefore proposed for this stratum. In fresh exposures, it is a bright green, finely laminated shale, but weathers to a bluish green. It has been found near Clinton, West Liberty, Wellsburg, and north to within a half mile of Cross creek."

The Chapline Hill section on page 262 of this report shows its position with relation to the Uniontown and Benwood limestone. The log of the Wm. W. Ewing core test well (M 15) on Wheeling creek 0.6 mile southwest of Viola, Marshall county, published on page 263, shows this stratum to be 4½ feet thick, coming 99 feet above the horizon of the Sewickley coal, and at a depth of 75′ 2″.

This green shale was not noted in the logs of the several core tests drilled along the Ohio river front of Marshall county. The log of the core test well (W 150) at Mobley P. O., Wetzel county, reports 7 feet of **green shale** at this horizon, coming immediately under the lower division of the Uniontown limestone and 15 feet above the top of the Benwood limestone. Here it also comes 60 feet below the Uniontown coal and 82 feet above the Sewickley bed.

The Benwood Limestone.

As mentioned above, the lower division of the Great Limestone of Rogers has been designated the **Benwood limestone** from its outcrop along the Ohio river hill at the town of that name in northwestern Marshall county, where it forms vertical cliffs, consisting of alternate layers of hard limestone and limy

7. Ohio-Brooke-Hancock County Report, p. 92, W. Va. Geol. Survey.

shale. Prof. G. P. Grimsley[8] gives the following description of this stratum in southern Ohio county and in northwestern Marshall:

"The limestone below the Fulton Green Shale forms vertical cliffs along Wheeling, Middle Wheeling, Little Wheeling, and Short creeks. It consists of solid layers alternating with shaly layers. The rock weathers in a very characteristic manner into angular fragments, giving the layers a complex fractured appearance as though broken by some sudden shattering force. It is this property of weathering into small fragments which soon break off that explains the vertical walls.

"Along the National road east of Elm Grove these steep cliffs of grayish white limestone, 20 to 60 feet in height, are conspicuous features in the topography. Back from the creeks this horizon even when covered with vegetation forms a steep slope closely approaching the vertical, so that this limestone is an important factor in the topography of the districts where it occurs.

"The limestone on fresh fracture is blue to black in color, but weathers to a light gray or buff. The lower layers are buff in color, breaking with a smooth almost slaty fracture, and are locally known as the cement beds or cement rock. In past years this portion of the limestone was burned for natural cement, but never on an extensive scale in this area. Both the lower and upper layers have been quarried for road material. It is popular with the workmen for this purpose as the rock can be easily quarried and readily broken with very little effort. When spread on the roads it soon breaks and crumbles to smaller and smaller pieces until it forms a dust.

"Near Benwood the limestone forms a cliff about 30 feet in height. The shaly layers weather more rapidly than the solid, thus leaving slightly projecting layers which give the surface of the cliff an undulating or wavy outline. The compact strata have their exposed edges traversed by the network of seams caused by weathering. As these fissured blocks break off and fall to the base of the cliff they leave freshly exposed surfaces of blue or black color between the light buff or gray weathered

8. Ohio-Brooke-Hancock Report, pp. 92-94, W. Va. Geol. Survey.

surfaces, thus giving a very peculiar spotted appearance to the cliff.

"It was from this locality that the name Benwood was selected for this limestone. Wherever this rock is exposed in the Pan Handle area the appearance of the cliffs is similar to those at Benwood. There is thus a marked contrast between the Benwood and Uniontown limestones, so that the two can be readily distinguished even where the Fulton green shale is absent or concealed.

"The Benwood limestone is 30 to 60 feet in thickness. Good exposures of the rock may be seen at the Cedar rocks near the Ohio-Marshall county line above Patterson on Wheeling creek, (illustrated in plate V), on the hill above the Wheeling Terminal railroad tunnel near Fulton, below Twilight on Middle Wheeling creek, and between Triadelphia and Roney's Point, along Little Wheeling creek and on the National road, along the river bluffs from Wheeling to Benwood, on North Fork of Short creek from a mile southwest of West Liberty to Shannon, and along many of the smaller creeks in the eastern part of Ohio county and in Brooke.

"The following section was made of the Benwood limestone one mile and a half west of Twilight on Middle Wheeling creek, and shows the typical structure of the formation:

	Ft.	In.
Limestone, solid	2	
Fulton green shale	3	
Limestone, shaly	6	
Limestone, solid	2	
Limestone, shaly	0	6
Limestone, solid	2	6
Limestone, shaly	3	
Limestone, solid	1	
Limestone, shaly	3	
Limestone, solid	1	6
Limestone, shaly	2	
Limestone, solid	1	
	27	6

"An average sample of the above layers below the Fulton green shale was analyzed, and showed the Benwood limestone in this area to be an impure rock, high in silicia and alumina,

and magnesium. This analysis when compared with one made from the lower portion of the formation, or the cement rock on Scott's run in Monongalia county, shows it to be much more impure. The lower beds in this area were not analyzed but they have the appearance of a magnesian limestone.

Analysis of Benwood Limestone.

	Near Twilight.	Scott's Run.
Lime carbonate	47.34	86.70
Magnesium carbonate	17.69	5.32
Silicia	22.22	5.96
Alumina	8.57	1.06
Iron oxide	2.01	1.27
Titanium	0.21	0.07

Passing on down the Ohio river from the Benwood region to the mouth of Hog run, ½ mile above Captina (Powhatan Sta.), this stratum is found cropping in a vertical cliff 20 to 25 feet high, coming immediately over the Sewickley coal also exposed in the bed of the latter stream. It retains here the same characteristic property of weathering into small fragments, forming the vertical cliffs. Its crop is exposed along the Baltimore & Ohio R. R. grade at Powhatan Station. In the several core test wells drilled in Marshall county it is composed of alternate layers of limestone and dark limy shale.

In Wetzel county the log of the Pine Grove boring (W 128) reports this limestone in typical development, but in the Jacksonburg core test well (W 177) it appears to have solidified into a great limestone, 58 feet thick, with 6 feet of dark slate 10′ 8″ above its base. In the Mobley core test well (W 150), it has the same 2 divisions, with 17 feet of fire clay with streaks of lime 8½ feet above its base, the whole having a thickness of 64 feet, or 6 feet greater than at Jacksonburg.

The detailed log of the Sarah Anderson No. 1 well in Church district, Wetzel, used by the writer in making the Burton section on page 110, shows a great limestone, 158 feet thick, coming immediately over the Sewickley coal, including, no doubt, both the Uniontown and Benwood formations.

In Tyler county this stratum was noted by the drillers in

the detailed logs of two wells bored for oil and gas. The first of these, the Moses Johnson No. 1 well (T 229), used in connection with the McKim section, page 118, shows 55 feet of limestone and shells occurring at this horizon. Its base there comes 69 feet above what the writer has identified as the Pittsburg coal. The other is the W. W. Myers No. 1 well (T 137) located on Big run of Indian creek, 2½ miles north of Big Moses P. O., and used by the writer in making up the Big Run section on page 114, of this report. The record of this well shows 115 feet of limestone at this horizon, coming immediately over the Sewickley coal, and 105 feet above the Pittsburg bed.

The Sewickley Sandstone.

Along the eastern crop of the Monongahela series a massive sandstone often comes into the section above the Sewickley coal and, according to Dr. I. C. White, cuts out all or a large portion of the Benwood and Uniontown limestones. Its outcrop is well exposed at Beechwood along the Monongahela river between Morgantown and Fairmont, where it occurs immediately over the Sewickley coal, attaining a thickness of 60 feet. It has been named by Dr. White the Sewickley sandstone from its relation to the coal bed.

In the Mobley P. O., Wetzel county, core test well (W 150) record 15 feet of **sandstone** occurs directly under the **Fulton Green shale** and over the Benwood limestone, the latter having a total thickness, including parting, of 64 feet and in immediate contact at its base with the Sewickley coal. It seems quite probable that this sandstone represents the Sewickley rock.

In Tyler county it appears to be this sandstone in the vicinity of Middlebourne that is called the "Hurry Up" sand by the drillers on account of its water bearing qualities. The following record of the J. G. King No. 1 well, drilled by the South Penn Oil Co., near the top of the hill, ½ mile north of Middlebourne, will show the position of this stratum:

Log of the J. G. King No. 1 Well, N. of Middlebourne.

	Thickness Feet	Total Feet.
Unrecorded	275	275
Coal, Washington	2	277
Unrecorded	193	470
Coal, Uniontown	1	471
Unrecorded	104	575
"Hurry Up" Sand (Sewickley)	40	615
Unrecorded	98	713
(Coal, Pittsburg, horizon supplied by writer)	0	713
Unrecorded	114	827
Cave (reds)	285	1112
Unrecorded	113	1225
Salt Sandstone?	548	1773
Unrecorded with Limestone at bottom	102	1875
"Dawson" Sand (gas at 1915, oil at 1918)	46	1921
Big Lime, Greenbrier Limestone	17	1938
Keener Sand	22	1960
(Oil at 1947', and a 15-bbl. well)		
Unrecorded to bottom of hole	13	1973

In this well the driller did not find any Pittsburg coal but the writer supplied its horizon by placing it 1225 feet above the top of the Keener sand, the amount of this interval in the J. R. Baker No. 1 well (T 111) just south of Middlebourne. It is evident then from the above well record that this much used "key rock" (Hurry Up Sand) by the oil fraternity in this region belongs about 100 feet above the Pittsburg coal or at the horizon of the **Sewickley sandstone.** Five miles east of Middlebourne the Hurry Up (Sewickley) sand is noted in several of the wells in the Big Injun sand oil pool on Muddy creek of Middle Island creek. There the log of the Isaiah Baker No. 2 well (T 123) shows this sandstone to be 30 feet thick, coming 83 feet above the Pittsburg coal also noted in the record, the latter bed coming 1258 feet above the top of the Keener sand.

The Sewickley Coals.

At 70 to 120 feet above the base of the Monongahela series occurs a coal seam of wide distribution, named the **Sewickley** coal by the first Geological Survey of Pennsylvania. This same bed has been mined near Mapletown, Greene co., Pa., under the

name **Mapletown coal** which is applied to this bed quite frequently by the oil well drillers in Ohio, Marshall, Wetzel and Monongalia counties. Prof. J. J. Stevenson gives the typical structure of this coal in Greene county:

	Ft.	In.
Coal	2	1
Clay	0	1
Coal	3	4
Total	5	6

In the State of Ohio this bed is known as the "Meigs Creek" coal from a stream in Morgan county along which it has a good development.

Next to the great Pittsburg bed the Sewickley seam is the most important coal from a commercial standpoint in the 3 counties. Dr. I. C. White[9] has the following to say concerning this coal:

"The coal has a fine reputation for domestic use among the farmers of Marion and Monongalia, who generally prefer it to the Pittsburg coal below, on account of its more open burning, and less fusing character in the grate. The coal is usually interlaminated by thin layers of mineral charcoal, and this structure causes it to burn up with a bright flame, leaving only a fine ash with little clinker, although it carries more ash and sulphur than the **Pittsburg coal** below. The coal is rather too hard to coke well without crushing and washing, but it mines in large blocks with no more fine coal than the Pittsburg, and bears transportation equally well.

"The coal, when possessing its normal thickness of five to six feet, is generally split into two members by a layer of slate one to three inches thick, near the center, and sometimes one or both members may be again subdivided by one or more thin slates."

This coal has been mined by shaft 12 miles east from the Wetzel county line near Underwood, Marion county, West Virginia, where the bed has the following detailed structure according to the same report quoted above:

9. Vol. II, p. 154, W. Va. Geol. Survey.

		Ft.	In.
Upper Bench	Coal 0 9		
	Slate 0 0¾		
	Coal 0 6	2	7¼
	Slate 0 0½		
	Coal 0 3		
Slate		0	1
Lower Bench (Coal)		3	4
Total		6	0¼

This section shows that this seam is double-bedded. In southern Ohio county, W. Va., just north from Marshall county, this bed is apparently split into 2 seams, separated by 10 to 25 feet of shales, as is well shown by the Creighton Slope Mine and Hill section on page 261. The upper bed is called the **Upper Sewickley** and the lower, the **Lower Sewickley** coal, and both may correspond to the Upper and Lower benches of this seam in the Underwood section given above, the 1 inch of black slate there having thickened up to 22 feet at the Creighton Slope mine.

In the three counties under discussion the crop of this coal occurs only along the Ohio river front of Marshall, being deeply buried below drainage in both Wetzel and Tyler. It has been opened up and mined for local domestic fuel at several points along Boggs run, and along the Ohio river between Benwood and Moundsville. An opening on the Catherine Smith farm on the west bank of Boggs run, due east of the B. & O. R. R. bridge over the Ohio river at Benwood, W. Va. gives the following structure:

					Ft.	In.
1	Limestone, Benwood					
2	Shaly fire clay				5	0
3	Coal	1′	0″			
4	Slate, gray	0	0⅛	Upper Sewickley	2	8⅛
5	Coal	1	8			
6	Slate					

The writer collected a sample at this mine for analysis, from which Prof. Hite reports the following composition:

Proximate Analysis.		Ultimate Analysis.	
Moisture	1.18%	Carbon	67.07%
Volatile Matter	33.93"	Hydrogen	4.89"
Fixed Carbon	50.77"	Oxygen	9.99"
Ash	14.12"	Nitrogen	1.16"
		Sulphur	2.77"
		Ash	14.12"
Total	100.00%	Total	100.00%

Phosphorus 0.006%
Sulphur .....2.77 %

Calorific value:
Calrimeter B. T. U.....12,537
Calculated B. T. U.....12,131

$$\frac{\text{Carbon}}{\text{Oxygen} + \text{Ash}} = \frac{67.07}{24.11} = 2.78$$

The crop of the Lower Sewickley coal is exposed along the river hill at Benwood where the following section was measured by the writer:

Coal	0′	2″
Slate, gray	0	3
Coal	0	9
Slate	0	0½
Coal	0	7
Slate	0	0½
Coal	0	5
Total	2′	3″

It is separated from the Upper Sewickley coal here by 18 feet of limy shale, coming about 50 feet above the Pittsburg bed. A sample of the Lower Sewickley coal was taken at this point for analysis, the composition of which Prof. Hite reports as follows:

Proximate Analysis.		Ultimate Analysis.	
Moisture	1.37%	Carbon	69.79%
Volatile Matter	38.00"	Hydrogen	5.46"
Fixed Carbon	49.04"	Oxygen	7.67"
Ash	11.59"	Nitrogen	1.54"
		Sulphur	3.95"
		Ash	11.59"
Total	100.00%	Total	100.00%

Sulphur	3.95%
Phosphorus	0.013%

Calorific value:

Calorimetrr B. T. U.	12,995
Calculated B. T. U.	13,101

$$\frac{\text{Carbon}}{\text{Oxygen} + \text{Ash}} = \frac{69.79}{19.26} = 3.62$$

Although this sample was taken from the crop where more or less weathering had taken place, yet the above analysis reveals a fuel of higher relative value as determined by its Carbon—Oxygen plus Ash ratio (3.62) for the Lower Sewickley than the same (2.78) for the Upper bed from the Smith mine on Boggs run, page 305.

The Sewickley coal was once mined on the east side of the public road on McMechen run at the north end of McMechen, but the opening is now abandoned. The coal is reported as 4′ thick and of fair quality. One mile south of this point occurs an old opening (now abandoned) in the Sewickley bed on Jim run at an elevation of 641′ A. T. where, according to Mr. C. C. McMechen of McMechen, W. Va., several thousand bushels of this coal were mined to supply domestic fuel for the farmers and residents of McMechen. Mr. McMechen claims a thickness of 5 feet of coal at this old mine. When the Pittsburg bed was opened up on a commercial scale both at Glendale and Benwood, this mine was abandoned. Farther down the Ohio river at the north end of the town of Glendale occurs another old abandoned mine in the Sewickley bed on the land of Louis Newman at an elevation of about 660′ A. T. Mr. William Auton, living nearby, says this mine furnished fuel for the farmers in this vicinity for several years and that the coal was 4 feet thick and about the same grade as the Pittsburg bed. This mine has been abandoned for about 25 years. From this point the Sewickley coal dips rapidly southward and at Moundsville is below the Ohio river on the W. Va. side. Farther down the river at the mouth of Hog run, ½ mile northeast of Powhatan station, this coal crop at a level with the latter stream and has there been opened on the John Hammond Heirs land at an elevation of 612′ A. T., coming 71 feet above the Pittsburg

bed as shown by the Hammond Core test well record, page 269 This coal has been mined here for local domestic use for 25 to 30 years. A new opening has just recently been started there, where the following section is exposd:

1	Limestone, interstratified with limy shale (Benwood)			25′	0″
2	Shale, black			1	6
3	Coal,	0′	9″		
4	Coal, bony	0	6	Sewickley	3 11
5	Coal	2	8		
6	Slate				

A sample for analysis was collected here, omitting the 6 inches of bony coal. The composition of the sample is reported as follows by Prof. Hite:

Proximate Analysis.		Ultimate Analysis.	
Moisture	0.98%	Carbon	68.65%
Volatile Matter	38.74″	Hydrogen	5.39″
Fixed Carbon	48.96″	Oxygen	10.50″
Ash	11.32″	Nitrogen	0.96″
		Sulphur	3.18″
		Ash	11.32″
Total	100.00%	Total	100.00%

Sulphur	3.18 %
Phosphorus	0.009%

Calorific value:

Calorimeter B. T. U.	———
Calculated B. T. U.	12,638

$$\frac{\text{Carbon}}{\text{Oxygen} + \text{Ash}} = \frac{68.65}{21.82} = 3.15$$

The Sewickley coal was once mined by a shaft 80 feet in depth at the north end of Cresap Bottom along the Ohio river, near Cresap station, and reported 4½ feet thick. The mine has been abandoned for 10 years, and the walls of the shaft have now caved shut.

The above chemical analysis of this coal along the Ohio river in Marshall county show this bed to be much more impure than the same coal along the Monongahela river as is revealed by the following analysis of this seam from the mine of the

Parker Run Coal & Coke Co.[10], located on the north side of the Monongahela river, just above and nearly opposite Montana Mines, Marion county, W. Va.

Proximate Analysis.		Ultimate Analysis.	
Moisture	1.15%	Carbon	77.63%
Volatile Matter	38.45"	Hydrogen	4.90"
Fixed Carbon	51.97"	Oxygen	4.53"
Ash	8.43"	Nitrogen	1.03"
		Sulphur	3.48"
		Ash	8.43"
Total	100.00%	Total	100.00%

Sulphur	3.48 %
Phosphorus	0.005%

Calorific value:

Calorimeter B. T. U.	14,187
Calculated B. T. U.	14,117

$$\frac{\text{Carbon}}{\text{Oxygen} + \text{Ash}} = \frac{77.63}{12.96} = 5.99$$

The Carbon—Oxygen plus Ash ratio (5.99) here is almost double that (3.15) for this bed at the Hog run mine near Powhatan Station.

The distribution and possible commercial area of this bed will be taken up in a later chapter of this report on the Coal Resources of the 3 counties.

The Sewickley Limestone.

At a few feet below the Sewickley coal there nearly always occurs a limestone that has been designated **the Sewickley limestone** by Prof. J. J. Stevenson from its relation to the coal of that name. Where its outcrop is exposed along the river hill at Benwood it is 25 to 30 feet thick and a light gray in color, breaking with a smooth and almost shelly fracture. In fact, at this point the Redstone coal is often absent so that the Sewickley and Redstone limestone form nearly a solid mass of rock 40 to 60 feet in thickness.

10. Vol. II. (a), p. 668, W. Va. Geol. Survey

Plate VIII.—Coal Mine in the Sewickley Bed at Mouth of Hog Run, One-half Mile Northeast of Powhatan Sta.

The composition of the Sewickley limestone near Wheeling and Benwood is shown by the following analyses from the Ohio-Brooke-Hancock report, page 100:

	East of Wheeling Opp. Carter's Run.	Benwood near Riverside.
Lime carbonate	74.58	54.97
Magnesium carbonate	10.63	25.08
Silica	9.96	16.40
Alumina	3.28	3.20
Iron oxide	1.54	
Titanium	0.10	

These analyses show this stratum to be high in silicia and magnesia.

The position of the Sewickley limestone is well shown in the many sections of the Monongahela series already given.

The Redstone Coal.

At 50 to 70 feet below the Sewickley coal and 20 to 50 feet above the Pittsburg bed occurs another seam that has been designated the **Redstone coal** by H. D. Rogers from its outcrop along Redstone creek, Fayette county, Pennsylvania. It has attained sufficient thickness at two or three different points in West Virgina to be mined on a commercial scale. A small area of this coal is found on Scott and Robinson runs, Monongalia county, where it attains a thickness of 4 to 6 feet and has been mined to a small extent for local domestic fuel. It appears there almost as good a fuel as the Sewickley and Pittsburg beds, both of which are present in good development in that locality.

In the Marshall-Wetzel-Tyler area, the Redstone coal horizon crops for only a short distance along the Ohio river front of northwestern Marshall county, but no coal was observed at this place. Southward it passes below drainage before McMechen is reached. It was noted in the several diamond drill borings in Marshall and Wetzel counties.

The core test well (M 15) on the Wm. W. Ewing farm on Wheeling creek, 3/5 mile southwest of Viola, Marshall county, published on page 263, reports 8 inches of Redstone coal at a

depth of 247′ 9″, coming 62′ 2″ below the Sewickley coal and 16′ 3″ above the Pittsburg bed. One-half mile southwest of Captina (Powhatan Sta.) on the Ohio river front of Marshall county, the log of the T. B. McFarland core test well (M 107), published on page 91 in connection with the section for Powhatan Sta., shows the Redstone coal to be 2½ feet thick, coming 19 feet above the Pittsburg bed. This is the greatest thickness for this coal reported in the 3 counties. Across the river in the State of Ohio this seam is known as "8-A", variable in thickness and of no economic importance. It appears to carry out this reputation in the Marshall-Wetzel-Tyler area, since only 1 mile northeast of the McFarland core test well (M 107) the log of the Hammond core test well (M 105), published on page 269, at the mouth of Hog run fails to report any coal at the horizon of the Redstone bed. About 5 miles farther down the Ohio river at Franklin Station the log of the C. Higgs core test well (M 109), published in connection with the section at Franklin station, page 94, fails to report any Redstone coal, as well as the log of the C. P. Wells core test well (M 111), page 270, in the southwest corner of Marshall. The log of the David Abersold core test well (M 112), however, located only 1 mile southeast of the Wells core test well (M 111) reports 13 inches of Redstone coal, coming 59.9 feet below the Sewickley coal and 23.6 feet above the Pittsburg bed.

On Fish creek, Marshall county, the record of the Nellie (Eugene) Workman core test well (M 115) at the mouth of Little Tribble creek, published in connection with the Graysville section on page 91, reports 14 inches of Redstone coal, coming 60.8 feet below the Sewickley coal, and 27.1 feet above the Pittsburg bed. The log of the Anderson core test well (M 95), published on page 266, on Whetstone run, about 2 miles due south of Meighen P. O., Marshall county, fails to report any Redstone coal. It is quite evident from the above data that it maintains its reputation for variability in Marshall county.

In Wetzel and Tyler counties the Redstone coal lies deeply buried below drainage at all points. In Tyler this coal was not noted in the logs collected by the writer, of the many oil and gas well records scattered over its area. In Wetzel, however,

the record of the J. N. Camden core test well (W 128), published in connection with the Pine Grove section on page 103, reports the Redstone coal 19 inches thick, coming 79½ feet below the Sewickley coal and 24¾ feet above the Pittsburg bed.

The log of the M. V. Anderson core test well (W 177), 1 mile southeast of a Jacksonburg, reports 2½ feet of black shale at the horizon of the Redstone coal, coming 81′ 5″ below the Sewickley coal and 28 feet above the Pittsburg bed. The record of the core test well (W 150) at Mobley P. O., Wetzel county, fails to report any Redstone coal. From the above data it is evident that the Redstone coal in the Marshall-Wetzel-Tyler area is of no economic importance, but only serves as a "marker" to help identify the Sewickley and Pittsburg beds.

The Redstone Limestone.

Most of the interval between the Redstone and Pittsburg coals is frequently occupied by a limestone that has been named the Redstone limestone by Prof. J. J. Stevenson from its relation to the coal bed of that name. This stratum varies in thickness from a few feet to 25 in Marshall and Wetzel counties. Its outcrop occurs in the area under discussion for only 2 to 3 miles along the Ohio river front south from the Ohio-Marshall county line. Prof. G. P. Grimsley[11] gives the following account of this stratum in the Benwood and Elm Grove regions:

"The Redstone limestone is well exposed on the slopes of Chapline hill and along the Ohio river bluffs south to Benwood. It was quarried at one time for fluxing stone at the Riverside steel plant and a tunnel was driven through the hill to Boggs run on this horizon. It forms the bed of Wheeling creek at Elm Grove and is quarried at the edge of that town for road material. In the Wheeling area the upper portion of the rock is quite shaly, but the lower part is a compact bluish gray rock breaking with a smooth fracture and quite hard.

"The chemical composition of the Redstone limestone near

11. Ohio-Brooke-Hancock County Report, p. 101, W. Va. Geol. Survey.

Elm Grove and at the tunnel near the Riverside steel plant is shown by the following analysis:

	Elm Grove.	Riverside.
Lime carbonate	76.86	79.42
Magnesium carbonate	5.22	6.81
Silica	11.87	11.60
Alumina	4.68	1.90
Iron oxide	1.97	
Titanium	0.09	

In all other portions of the 3 counties, this stratum is deeply buried below drainage, but noted in the logs of the several core test wells of Marshall and Wetzel.

The Upper Pittsburg Sandstone.

The interval between the Pittsburg and Sewickley coals is quite variable when studied in different parts of the Appalachian coal basin. Often a massive sandstone occurs, immediately overlying the Pittsburg coal. This stratum has been designated by H. D. Rogers the **Pittsburg Sandstone** from its relation to the coal bed. The conditions in the Fairmont region of W. Va. are described by Dr. I. C. White[12] as follows:

"In the Fairmont region and especially along the eastern crop of the Pittsburg coal, there is often found a thick, coarse, gray sandstone, usually very soft, and readily disintegrating when exposed to the weather. When this sandstone is present in a massive condition the overlying Redstone coal and limestone are nearly always absent. * * * * * When massive, the sandstone contains much feldspathic material and easily disintegrates into a bed of coarse sand where exposed along the roads, etc. It has been quarried to some extent for building stone in the Fairmont region, but it furnishes a poor quality which stains badly and will not long endure the action of the elements."

In Marshall and Wetzel counties, the detailed logs of the many core test wells already mentioned would seem to indicate the absence of any massive sandstone at this horizon, but south-

[12]Vol. II, p. 163, W. Va. Geol. Survey.

westward in Tyler county the detailed record of the Moses Johnson No. 1 well (T 229), published in connection with the McKim section, page 118, shows 17 feet of sandstone, coming directly over the Pittsburg coal. The detailed log of the W. W. Myers No. 1 well (T 137) near the head of Big run of Indian creek, 7 miles east of Middlebourne, publishd in connection with the Big run section on page 114, shows the Pittsburg sandstone 30 feet thick, coming 40 feet above the Pittsburg coal.

The Pittsburg Coal.

The last and lowest member of the Monongahela series is the celebrated Pittsburg coal bed, the most valuable and important coal from an economic standpoint in the Appalachian field. It was named in 1856 by J. P. Lesley from the city of Pittsburg, Pa., where it crops high up in the river hills. Dr. I. C. White has the following to say concerning this stratum in Vol. II., page 164 of the State Survey reports:

"Among the rich mineral deposits of the great Appalachian field, the Pittsburg coal bed stands preeminent. Other coal beds may cover a wider area, or extend with greater persistence, but none surpasses the Pittsburg seam in economic importance and value. It was well named by Rogers (H. D.) and his able assistants of the First Geological Survey of Pennsylvania in honor of the city to whose industrial growth and supremacy it has contributed so much. Whether or not the prophetic eye of that able geologist ever comprehended fully the part which this coal bed was to play in the future history of the city which gave it a name we do not know; but certain it is that the seven feet of fossil fuel which in Rogers' time circled in a long black band around the hills, and overlooking the site of Pittsburg from an elevation of 400 feet above the waters of the Allegheny and Monongahela, extended up the latter stream in an unbroken sheet for a distance of 200 miles, has been the most potent factor in that wonderful modern growth which has made the Pittsburg district the manufacturing center of the world.

"That this claim for the supremacy of the Pittsburg district (including Wheeling and the Monongahela river region) is valid

can hardly be doubted, when we see its iron, steel, glass and other products going to every part of the western continent, and even invading the long established manufacturing dynasties of Europe."

The outcrop of the Pittsburg bed in the Marshall-Wetzel-Tyler area is shown on the economic geology map accompanying this report, and is confined to the Ohio river front in the northwest corner of Marshall county. It passes below the Ohio river at McMechen and its horizon with the above exception lies deeply buried below drainage over the rest of the area of the three counties. As related on a preceding page in the chapter on Structure, this stratum is largely used by the oil well driller as a key rock to determine the position of the oil and gas bearing sands. The map accompanying this report shows the tidal elevation of this great coal bed at all points in the 3 counties by means of structure contours. This same map also shows the location of the many oil and gas wells, dry holes and diamond drill borings, scattered over the area. The wells on which elevations were taken have been numbered on this map from 1 up in each county, and these several wells have been tabulated in consecutive order to correspond with the number on the maps, along with the depth to the Pittsburg coal, and its thickness in a great many cases as well as the depth and thickness in several cases to the Big Injun and Gordon sands. These tables are published by counties in a later chapter of this report on Oil and Gas, to which the reader is referred for information concerning thickness and depth to this great coal bed in the 3 counties. The records of these many wells show that the entire area of Marshall county, with the exception of a narrow strip of the Ohio river bottom, stretching from McMechen north to the Ohio county line, is underlaid by the Pittsburg coal, having a thickness ranging from 5 to 8 feet. In Wetzel county a different condition is found to prevail. The northeast ⅔ of its area is underlaid by Pittsburg coal, ranging in thickness from 5 to 10 feet (according to the driller's log), but the southwest part of the county appears to be barren of Pittsburg coal of commercial thickness, although its horizon is deeply buried below drainage. The western margin of the Pittsburg coal in Wetzel county is

indicated on the economic geology map accompanying this report.

In Tyler county the Pittsburg coal is conspicuous by its absence. In many cases the oil well driller notes 1 to 2 feet of **black slaty material** at the horizon of the Pittsburg bed, but in many cases no bituminous matter is found. At several scattered points over Tyler county, 5 to 6 feet of Pittsburg coal is reported in close proximity to other wells in which the coal was not noted. In the table of oil wells for Tyler county, the **depths** and tidal **elevations** of the Pittsburg coal horizon is in most cases supplied by the writer by calculating its interval above the Big Injun sand, and in such cases these figures are placed in parentheses.

Structure of the Pittsburg Coal.

Prof. J. J. Stevenson was the first geologist to make a detailed study of the structure of this coal bed. In Report K of the Second Geological Survey of Pa., he shows that a series of thin parting clays and slates subdivide the seam into several distinct beds which are as follows:

1. Roof coals.
2. Over-clay.
3. Breast coal.
4. Parting.
5. Bearing-in coal.
6. Parting.
7. Brick coal.
8. Parting.
9. Bottom coal.

The **roof coal** varies from a few inches to 8 feet thick. It is often divided into several layers by thin parting slates, some of which contain fairly pure coal. In the Benwood and Moundsville regions of Marshall county this roof coal varies in thickness from 12″ to 18″ and is always left up in mining to help support the roof, since as a rule 6 to 8 feet of gray limy shales intervene between the Pittsburg coal and the Redstone limestone above. On exposure to the atmosphere these shales readily disintegrate and cause rock "falls" when the roof coal is taken down.

The **over-clay** is an impure fire clay, varying in thick-

ness from a few inches to 2 feet and sometimes 5. It is usually much slicken-sided, and if left up in mining, becomes a dangerous trap, and for this reason is always removed. It has these same general features in the mines at Benwood and Moundsville.

The **breast coal** is the next succeedling or downward division of the bed, and along the Monongahela river in Pa. is the thickest or main bench. It thins down westward to the Ohio river and at Benwood, Glendale and Moundsville is only 2 feet thick.

The **bearing-in coal** was so named by the Monongahela river miners, because in mining operations the undercutting was generally done in this portion of the bed, the "breast" coal there being wedged or blown down, and the "brick" division afterwards taken up. The bearing-in coal, bright and brilliant in color, generally runs from 4 to 8 inches thick, and is included between the twin slates or partings each of which vary from ⅛ to ¾ inch in thickness. In the Benwood and Moundsville mines of Marshall county this division of the coal runs on the average about 5 inches in thickness, and the twin slates ½ inch each.

The **brick coal** comes next under the lower of the twin slates and was so named by the Monongahela river miners because the coal when mined there from this division of the bed comes out in oblong rectangular blocks, resembling the shape of common bricks, hence the name. There it is usually about 1 foot thick. In the Benwood, Glendale, and Moundsville mines in Marshall county this division of the Pittsburg coal runs about 18 inches thick. In the Fairmont, W. Va., region the Pittsburg coal is generally undivided below the lower twin slate, but in the Benwood-Moundsville region of Marshall the "brick" division is generally separated from the "bottom" coal by a sulphur band, ⅛ to ½ inch thick, called the "wedge" bench, so named for the reason wedges are generally driven here to force up the "brick" coal, after the "breast" and "bearing-in" divisions have been removed. Often this division is represented by only a soft "sooty" streak, and sometimes it disappears entirely and then the entire thickness below the lower twin slate is called bottom coal.

The **bottom coal** is the last and lowest division of the Pitts-

burg bed, and along the Monongahela river ranges from 12 to 20 inches in thickness. There it contains so many thin slaty and sulphurous partings that it is often not taken out in mining. In the Moundsville, Glendale, and Benwood region of Marshall county, this division of the Pittsburg bed averages about 18 inches in thickness, and sometimes carries a sulphur band, ¼ to ½ inch thick, 4 to 6 inches above its base. The sulphur band when present often contains hard nuggets of sulphide of iron which when struck with the miner's pick emit sparks of fire and for this reason is often called the "fire parting" by the miners in the Benwood region.

The structure as described above for the Pittsburg bed is so characteristic in Pennylvania, Ohio, Maryland, and West Virginia, that it is often easily identified wherever found in these four states by this feature. Dr. I. C. White[13] has the following to say concerning the structure of this bed.

"This type of structure is practically universal over all of the Pennsylvania, Maryland, and eastern Ohio area of the bed. The different members vary considerably in thickness, as for instance the gradual increase of the "breast" coal from three feet at Pittsburg to six feet at Brownsville, 58 miles up the Monongahela river, or to seven and even ten feet in the Georges creek and North Potomac regions of Maryland and West Virginia, or a decrease may take place in the same to thirty and sometimes to twenty inches, as in the Wheeling and Bellaire regions, but each of the main sub-divisions can be distinctly recognized, so that whether at Fairfax Knob, on the summit of the Alleghany mountains, 3200 feet above the level of the sea, or deep down in the center of the great Appalachian trough buried under 1500 feet of sediments, the explorer can readily identify this great coal bed, not only from its associated rocks, but from its stratigraphical elements as well, and from even the fracture of the coal."

The structure of this bed along the Monongahela river in West Virginia is well illustrated by the following section of the Opekiska mine 10 miles below Fairmont.[14]

13. Vol. II., p. 171, W. Va. Geol. Survey.
14. W. Va. Geol. Survey, Vol. II., p. 174.

				Ft.	In.
Roof coal				0	11
Black slate				0	5
Breast coal	Coal	1	8	3	4 ½
	Bone	0	½		
	Coal	1	8		
Bands	Bone	0	¾	0	6 ½
	Coal	0	5		
	Bone	0	¾		
Bottom coal				4	1

In Belmont county, State of Ohio, the writer measured the following typical section of the Pittsburg coal at the Pultney mine of the Cambria Mining Co., located along the Ohio river, opposite McMechen, Marshall county, W. Va.

	Ft.	In.
Coal, "roof" with shale partings 12″ to	2	0
Slate, gray, draw slate 10″ to	1	0
Coal, "breast"	2	1
Slate, black	0	0 ¼
Coal, "bearing-in"	0	5
Slate, black	0	0 ½
Coal, "brick"	1	7
Sulphur band, "wedge bench," ¼″ to	0	½
Coal with sulphur band at bottom, "bottom coal"	1	6
Total	8	8¼

The following typical section, illustrating the structure of the Pittsburg coal in the Marshall-Wetzel-Tyler area was measured by the writer in the Hosack mine of the Hitchman Coal & Coke Co. at Benwood, Marshall county:

			Ft.	In.
Roof coal			1	6
Over clay (draw slate)			1	0
Coal, "breast"			2	0
Bands	Slate	0′ 0½″	0	5
	Coal	0′ 4″		
	Slate	0′ 0½″		
Coal, "brick"			1	6
Sulphur band, "wedge bench"			0	0 ¼
Coal with sulphur band near bottom			1	6
Total			7	11 ¼

The area and chemical composition of the Pittsburg coal is taken up in the chapter on coals.

CHAPTER VI.

THE CONEMAUGH SERIES.

The next beds in descending order below the Monongahela series is a group of rocks that were formerly known as the Lower Barren Measures, and later as the Elk River series. The earliest name given to this series, however, was **Conemaugh** by Franklin Platt in 1875 from the outcrops along a stream of that name in Cambria county, Pennsylvania.

The Conemaugh series as now limited includes all the strata from the floor of the Pittsburg coal down to the roof of the Upper Freeport coal bed, the whole having a thickness of from 300 to 400 feet along its western outcrop in Ohio to 600 feet in eastern Monongalia county, W. Va. The top of the Conemaugh series just barely gets above the Ohio river bottom at Benwood and even there it is concealed by river gravel and debris. At all other points in the Marshall-Wetzel-Tyler area this series is deeply buried below drainage. It has, however, been penetrated in all portions of the 3 counties by the drill of the petroleum seeker, and its "Big Reds" give the latter no end of trouble on account of their caving qualities, and for that reason a brief description of the lithological character of its beds is of special interest to the oil and gas fraternity.

The following account is given by Dr. I. C. White[1]:

"The series as thus limited below, consists of two widely different members, lithologically considered, the upper composed largely of soft, red and marly shales, the lower of massive, pebbly sandstones. The difference in the rock type is so marked, and especially in the character of the topography made by each, that the First Geological Survey of Pennsylvania and Virginia placed them in two different series, the massive sandstones, at

1 Vol. II., p. 225, W. Va. Geol. Survey.

the base of the Conemaugh, being classed with the underlying Allegheny. That assignment, based primarily upon difference of rock type, was more philosophical than the present limitations, but the fact that no definite boundary (a sandstone always being subject to sudden and rapid changes in both thickness and character) could be assigned to either the lower limits of the upper one, or the upper limits of the lower one, led Profs. Stevenson, Lesley, and other Pennsylvania geologists to extend the limits of the "Lower Barren Measures" of Rogers down to the horizon of the Upper Freeport coal, a well marked and widely persistent stratum. This arrangement gives definiteness to classification, a great desideratum, but it has the fault of bringing together rocks of very different type, and hence, while apparently preferable to the old and indefinite dividing line between the two series, is yet not altogether satisfactory. Hence, it is possible that a future and more detailed study of the series in West Virginia, may reveal some more desirable dividing plane between the Conemaugh series and the underlying Allegheny than the present one, (U. F. coal), which will retain all of the desirable features of the Rogers classification and at the same time relieve it of indefiniteness.

"Viewed from the standpoint of change in physical conditions the proper place for such a dividing plane between the Conemaugh and Allegheny beds, would be the first general appearance of RED ROCKS, near the horizon of the Bakerstown coal about 100 feet under the Ames or Crinoidal limestone horizon. That a great physical change took place soon after the deposition of the Mahoning sandstone rocks, the present basal members of the Conemaugh series, must be conceded, since no RED BEDS whatever are found from the base of the Pottsville up to the top of the Allegheny, and none worth considering until after the epoch of the Upper Mahoning sandstone.

"The sudden appearance or disappearance of RED sediments after their absence from a great thickness of strata is always accompanied by a great change in life forms, and the present one is no exception. In fact, the invasion of RED SEDIMENTS succeeding the Mahoning sandstone epoch of the Conemaugh may well be considered as the "beginning of the end" of the

true Coal Measures, both from a lithological as well as a biological standpoint, and hence it is possible that the best classification aside from the conveniences of the geologist, would, leave the Mahoning sandstone in the Coal Measures, and place the rest of the Conemaugh, as well as the Monongahela series above, in the Permo-Carboniferous. This reference is also confirmed by the character of the fauna and flora, both of which contain many forms that characterize the Permo-Carboniferous beds of Kansas and the west as may be seen in the lists published on a subsequent page under the detailed description of the principal Conemaugh strata. * * * * The lowest 150 feet of these reds is known among oil well drillers as the "Big red cave," since it gives much trouble to them in drilling for gas and oil.. The wall of the well through this portion of the columns of rocks must be quickly lined with casing, or it will "cave" and crumble into the hole from the pressure of the overlying strata, thus often imprisoning the drilling tools and leading to the abandonment of the boring. The nuggets of hard limestone scattered through these red shales constitute the chief agent in this imprisonment, since they readily tumble out from the walls of the hole, and impinging against the drilling tools, principally at the "jars," prevent their withdrawal.

"For these reasons, every oil well driller becomes an expert stratigrapher in tracing these RED BEDS underground, and they have been so traced in hundreds of borings entirely across the state, when deeply covered by the overlying Monongahela and Dunkard series, so that whether at the surface and visible in broad bands of RED SOIL around the hills, or buried under 2000 feet of higher sediments, the same deep purple and red shales exist in this portion of the geologic column along the belt of country west from the mountain region of the state. Hence the color is not the result of recent oxidaton, but is evidently due to the deposit of RED SEDIMENTS derived from the erosion of old land areas of pre-carboniferous time."

The following section, measured by Dr. I. C. White[2] in Allegheny county. Pa., shows the succession and character of the rock material composing the Conemaugh series:

2. Report 'Q'. p. 24: 1876. 2nd Geol. Survey. Penn.

General Section of the Conemaugh Series in Allegheny Co., Pa.

	Feet		
Pittsburg Coal.			
Concealed	20		
Upper Pittsburg limestone	2		
Variegated shales	65		
Little Pittsburg coal (wanting)	0		
Lower Pittsburg limestone	5		
Red shales	20		
Concealed	70		
Morgantown sandstone	45		
Variegated shales	50		
Elk Lick coal	0	to	3
Elk Lick limestone	0	to	5
Variegated shales	35		
Ames Limestone	2	to	3
Harlem coal	0	to	1 ½
Red shales, Pittsburg	30		
Sandy shales and shaly sandstone	50		
Bakerstown (Barton) coal	0	to	4
Shales and sandstone	40		
Cambridge (Pine Creek) limestone	2		
Buffalo sandstone	60		
Brush Creek limestone	1	to	2
Dark shales	10	to	15
Brush Creek coal	0	to	2
Shales	20		
Mahoning sandstone	40	to	80
Mean height of section 600 feet.	570	to	630

A fine section of the Conemaugh series along the Ohio river front was obtained from the log of a diamond drill boring at Glenova, W. Va., 6½ miles north from the Ohio-Marshall county line. This record was compiled by Dr. I. C. White from the core samples and published in the Introduction to the Ohio-Brooke-Hancock County Report and the part included in the Conemaugh series is as follows:

Glenova, Ohio County, W. Va. Boring.

Well mouth above tide ..... 672′ 2″

	Thickness Ft.	Thickness In.	Depth. Ft.	Depth. In.
1 Clay, dark yellowish, plastic	6	4	6	4
2 Sand, coarse, brownish-gray, with pebbles of quartz, silex, and other hard materials, nothing larger than ¼″ by ½″ in size	43	8	50	0
3 Sand, brownish-gray, finer, no pebbles	12	0	62	0
4 Sand, coarse, brown, much oxidized, few pebbles	6	0	68	0
5 Sand, fine, yellowish-brown, no pebbles	19	0	87	0

		Thickness. Ft.	In.	Depth. Ft.	In.
6	Sand, dark gray, coarse, mixed with clay at bottom	6	0	93	0
7	Bed rock, bluish-gray, fine grained sandstone	0	6	93	6
8	**Limestone, Ames,** with fossil Crinoids and **Productus Nebrascensis**	0	3	93	9
9	Clays and shales, much red and variegated (Pittsburg red shale)	18	6	112	3
10	Shales, sandy, gray	6	9	119	0
11	Fire clay, sandy	1	0	120	0
12	Shales, greenish-gray, sandy	4	3	124	3
13	Shales, red and variegated (base of Pittsburg red shale)	16	6	140	9
14	Sandy shales interstratified with micaceous shaly sandstones	57	6	198	3
15	Shales, dark, sandy with fossil plant fragments	1	9	200	0
16	Shales, sandy, dark gray	6	6	206	6
17	Shales, dark, fossil shells, crinoids, etc.	1	6	208	0
18	Limestone, impure, fossiliferous	0	10	208	10
19	Shale, dark, sandy	2	0	210	10
20	Coal, **Bakerstown (Barton)**	0	8	211	6
21	Fire clay, sandy, impure, variegated at base	4	0	215	6
22	Shales, red and variegated	10	2	225	8
23	Shales, limy, very fossiliferous. **Chonetes granulifera C. mesoloba., Productus Nebrascensis, P. semireticulatus Fenestella, etc.**	2	8	228	4
24	**Limestone, Cambridge,** fossil crinoids, etc.	0	4	228	8
25	Fire clay, impure, sandy	6	4	235	0
26	Shales, light gray, sandy	40	4	275	4
27	Shales, dark gray, fossiliferous. **Aviculopecten** numerous	11	10	287	2
28	Shales, light gray, sandy	27	0	314	2
29	Limy, fossiliferous shale, dark **(Brush Creek limestone)**	1	4	315	6
30	Shales, sandy, micaceous, gray	4	6	320	0
31	Shales, dark gray, fossiliferous, many **Aviculopectens**	11	0	331	0
32	Bituminous slate	1	4	332	4
33	**Coal, Brush Creek, hard, semi-cannel**	0	6	332	10
34	Fire clay, impure, sandy	2	2	335	0
35	Fire clay, limy	5	0	340	0
36	Fire clay, stained red with iron	3	10	343	10
37	Shale, gray, sandy with streaks of impure fire clay	19	11	363	9

The base of the **Pittsburg coal** here comes 104½ feet (spirit level measurement) above the top of the bore hole, giving a thickness of 475 feet for the Conemaugh series.

In the Marshall-Wetzel-Tyler area the only information to

be obtained concerning the character and thickness of the Conemaugh series is that obtained from the detailed logs of a few wells in each of the 3 counties.

In the northwest portion of Marshall county, the log of the Boggs run deep well, located 8½ miles due south of the Glenova boring given above, published on page 82, gives a thickness of 530 feet for the Conemaugh measures.

On Wheeling creek, the record of the Geo. P. Folmar No. 1 well (M 8), given in connection with the general section for Grandstaff run, page 77, shows the Conemaugh series having a thickness of 526 feet. In the extreme eastern part of Marshall county on Wheeling creek, the section given for Majorsville, page 80, shows the Conemaugh 525 feet thick, as well as the absence of coal seams. This section shows an unusual amount of red rock in the lower portion of the series.

In the northwest corner of Wetzel county, the detailed log of the Sarah Anderson No. 1 well (W 1) published on page 110, in connection with the Burton section gives an approximate thickness of 550 feet for the Conemaugh series. This record gives many details of the series and the drillers log calls for 5 feet of **Bakerstown (Barton) coal**, coming 325 feet below the Pittburg bed, as well as 3 feet of **Mahoning coal**, coming 38 feet above the base of the series. The **Saltzburg, Buffalo, Upper Mahoning** and **Lower Mahoning** sandstones are all present in good development. The upper half of the series is mostly limy shales and red beds. The detailed log of the Blackshere, Wells & Co. No. 5 well (W 198), published on page 108 in connection with the Arches Fork section in the southeast corner of Wetzel county, gives an approximate thickness of 560 feet for the Conemaugh series. In this region it appears entirely barren of coal. The **Pittsburg red shale**, or "Big Reds" of the oil well drillers, is reported 80 feet thick, coming 265 feet below the Pittsburg coal. The **Saltsburg** and **Mahoning** sandstones are present in good development.

In Tyler county the Conemaugh series of rocks is all deeply buried below drainage, but the records of many oil and gas wells reveal the absence of any coal seams of economic importance.

The log of the W. W. Myers No. 1 well (T 137), located 6½ miles east of Middlebourne and used in connection with the Big run section, page 114, shows the Conemaugh having a thickness of 574 feet. It also shows the absence of any coal beds.

DESCRIPTION OF FORMATIONS.

The Conemaugh series include the following formations, having a total thickness of from 475 feet in northwest Marshall county to 575 feet in southeast Wetzel county:

Lower Pittsburg Sandstone.
Pittsburg Limestones.
Little Pittsburg Coals.
Connellsville Sandstone.
Little Clarksburg Coal.
Clarksburg Limestone.
Morgantown Sandstone (Murphy Sand).
Elk Lick Coal.
Elk Lick Limestone.
Birmingham Shale.
Ames (Crinoidal) Limestone.
Harlem (Crinoidal) Coal.
Pittsburg Red Shale.
Saltsburg Sandstone (First Cow Run Sand).
Bakerstown (Barton) Coal.
Pine Creek (Cambridge) Limestone.
Buffalo Sandstone.
Brush Creek Limestone.
Brush Creek Coal.
Upper Mahoning Sandstone (Big Dunkard Sand).
Mahoning Coal.
Lower Mahoning Sandstone.

Of the several formations given above only the Pittsburg Red shale, Saltsburg and Mahoning or Dunkard sand appear to be noted in the logs of the oil well driller. The former has already been described and the latter two are to be taken up in the Chapter on Oil and Gas. The series appears to be entirely barren of any coals of economic importance.

CHAPTER VII.

THE ALLEGHENY SERIES.

The next group of rocks in descending order below the Monongahela series is what was formerly known as the Lower Productive Measures, but which was named by H. D. Rogers, the Allegheny, extending to above the Mahoning sandstone. The Allegheny series as now limited and recognized by geologists, was first described in 1875 by F. Platt of the Pennsylvania Survey as extending from the top of the Upper Freeport coal down to the top of the Homewood or Tionesta sandstone of the Pottsville series.

Dr. I. C. White has the following to say concerning this series of rocks in Vol. II., pp. 333-334, W. Va., Geol. Survey reports: "As already related, the original nomenclature of Rogers included the Mahoning sandstone in this series, thus extending 100 to 150 feet above the present top of the Allegheny beds as limited by later geologists. That these sediments thus formerly included in the Allegheny measures are more nearly related to the main portions of the Allegheny beds below than to those which overlie the Mahoning sandstones with great masses of red shale, and holding faunas and floras closely related in many respects to the Permo-Carboniferous rocks of the west, has already been stated. Whether convenience and reasonable certainty in classification should outweigh real affinity, is the only question involved as to whether the classification should remain as now constituted, and used in this volume, or whether it should be revised by a substantial return to the less convenient but more philosophical usage of the earlier geologists of Pennsylvania. This question can hardly be decided until after the entire Coal Measures sediments have been carefully studied in detail, with the aid of the new and more accurate maps, and vaster mining enterprises, shafts, borings, etc., to which the younger school of

geologists will have access, but which were denied to their predecesors.

"The Allegheny series, as here limited, is capped at the top with widely distributed, easily recognized, and valuable Upper Freeport coal bed, and extends down through several beds of fire clay, limestone, coal, shale, and sandstone, until a marked change in lithology takes place, the sandstones becoming harder, more massive, often very pebbly, and of a lithologic type quite different from the ordinary sandstones of the Allegheny series, accompanied, of course, with a change in the character of the imbedded fossil plants. The physical change at the base of the series is generally very striking, so that the observer, once familiar with the lithologic type of the Allegheny sediments, finds but slight difficulty in differentiating the basal beds of the latter from the underlying Pottsville. True, sometimes the members of the Freeport sandstone grow very massive and conglomeratic and assume a type that is so like the Pottsville as to readily lead the stratigrapher into error, especially where the full series is not exposed, but this is only a local and temporary phase, and can always be avoided by a careful study of the overlying Conemaugh beds.

"The thickness of this Allegheny series varies greatly in different portions of the field. Entering the state from Pennsylvania in Monongalia and Preston counties, the series has in Monongalia a minimum thickness of about 225 feet, which soon expands eastward to 275 to 300 in Preston, and slightly more in Mineral and Grant."

The following section, measured by Dr. I. C. White[1], from the localities where the coals of the Allegheny series received their names is given here to show the order and character of the rocks of the series:

Section Near Kittanning, Pennsylvania.

	Ft.	In.
Upper Freeport coal	4	
Shales and concealed	35	
Coal, Lower Freeport	2	
Concealed and massive sandstone	35	

[1]Bulletin 65, p. 111, U. S. Geol. Survey.

	Ft.	In.
Shales and sandstone	40	
Coal slate in center, **Middle Kittanning**	1	6
Fire clay	4	
Sandy shales	6	
Fire clay	3	
Flaggy sandstone	17	
Shales, dark, sandy, with iron ore	40	
Coal, Lower Kittanning	3	3
Fire clay	5	
Sandstone and sandy shales	40	
Shales with iron ore	5	
Iron ore, Buhrstone	0	6
Limestone, Ferriferous	11	6
Sandy shales	15	
Coal	0	3
Sandy shales and sandstone	21	
Coal, Clarion	1	
Concealed to top of No. XII sandstone	25	
	315	

A fine section of the Allegheny series was obtained from the log of a diamond drill boring at Glenova, Ohio county, W. Va., 6½ miles north from the Ohio-Marshall county line. This record was compiled by Dr. I. C. White, as heretofore mentioned, from the core samples and published in the Introduction to the Ohio-Brooke-Hancock County Report, and the part included in the Allegheny series is as follows:

Glenova, Ohio County, W. Va., Boring.

		Thickness Ft.	In.	Depth to bottom. Ft.	In.
	Upper Freeport coal horizon.				
38	Limestone, gray	1	9	365	6
39	Fire clay, limy and sandy	2	11	368	5
40	Limestone, gray	2	0	370	5
41	Shale, sandy, and impure fire clay	2	7	373	0
42	Limestone, gray, minute fossils (fresh water)	4	0	377	0
43	Fire clay **(Bolliver?)** limy, and sandy stained reddish in middle for 3 ft	13	0	390	0
44	Shale, gray, sandy	5	0	395	0
45	Sandstone, gray, micaceous	6	6	401	6
46	Shale, gray, sandy	5	0	406	6
47	Fire clay	4	0	410	6
48	Shale, sandy, light gray	5	0	415	6
49	Sandstone, micaceous, laminated	7	4	422	10
50	Shale, sandy, gray interlaminted with layers of micaceous sandstone, slight flow of gas in this interval	10	11	433	9

		Thickness		Depth to bottom.	
		Ft.	In.	Ft.	In.
51	Bituminous slate, fossil fish scales	0	9	434	6
52	Shale, sandy, or impure fire clay	1	8	436	2
53	Shale, limy, dark	1	2	437	4
54	Limestone, light gray, rather pure	2	8	440	0
55	Limestone and clay	5	0	445	0
56	Clay and shales	3	6	448	6
57	Shales, dark	0	9	449	3
58	Coal, **Lower Freeport, "Steubenville shaft seam," "Roger vein,"** etc., small flow of gas	3	9	453	0
59	Fire clay	0	6	453	6
60	Sandstone, micaceous	2	6	456	0
61	Coaly streak	0	1	456	1
62	Shale, gray, sandy	3	11	460	0
63	Shale, gray, sandy with thin streaks of micaceous sandstone	20	0	480	0
64	Sandstone, micaceous with thin layers of sandy shale	8	0	488	0
65	Sandstone, hard. micaceous, with streaks of coal near base	22	6	510	6
66	Fire clay, dark, sandy	5	0	515	6
67	Sandstone, hard, gray, micaceous with streaks of coal	3	6	519	0
68	Coal **(Upper Kittanning)**	0	4	519	4
69	Fire clay, sandy in lower half	9	2	528	6
70	Shale, gray, sandy	8	6	537	0
71	Fire clay, impure, and sandy shales	9	4	546	4
72	Sandstone, micaceous, shaly	3	8	550	0
73	Sandstone, coarse. micaceous. pebbly for 5 feet at base	27	4	577	4
74	Shales, sandy, gray	4	2	581	6
75	**Coal, Lower Kittanning**	0	2	581	8
76	**Fire clay, good, Lower Kittanning**	20	4	602	0
77	Shale, gray, sandy	3	8	605	8
78	**Homewood sandstone, top**				

The Allegheny series appears to extend from No. 37 to No. 78, giving it a thickness of (605 feet 8 inches less 363 feet 9 inches) 242 feet. The only coal here of economic importance is the Lower Freeport bed, the position of which with reference to the Pittsburg bed is graphically shown in Fig. 2. The log of the above boring possibly represents closely the character of the Allegheny series in the Marshall-Wetel-Tyler area.

In northern Marshall county, on Wheeling creek, the log of the Geo. P. Folmar No. 1 well (M 8), given in connection with the section for Grandstaff run on page 77, shows the Allegheny as having approximately a thickness of 283 feet. The **Upper Kittanning coal** is there given a thickness of 3 feet, coming 669 feet below the Pittsburg bed. Farther up Wheeling creek the log of the S. T. Alley No. 1 well at Majorsville, located just below the town on the north bank of the latter stream, and published in the Majorsville section on page 80, gives the approximate thickness of the Allegheny in this part of Marshall county as 270 feet. There the Lower Freeport coal is reported 3 feet thick, coming 587 feet below the Pittsburg bed.

The log of the J. T. Cox[2] No. 1 well (M 24) near the head of Wolf run, Webster district, Marshall county, gives the following succession for the Allegheny series:

	Thickness. Feet.	Depth from top. Feet.	
Sand, (Upper Freeport)	20	1160	
Break	35	1195	
Coal, Lower Freeport	5	1200	
Slate	10	1210	280'
Gas Sand **(Lower Freeport)**	70	1280	
Slate	70	1350	
Sand	10	1360	
Slate	60	1420	
"Salt Sand."			

The approximate thickness of the Allegheny is there shown to be 280 feet. The **Lower Freeport coal** is reported 5 feet thick, coming 615 feet below the Pittsburg bed.

In Church district, Wetzel county, on Church fork of Fish creek, the detailed log of the Sarah Anderson No. 1 well (W1), published on page 110 in connection with the Burton section, gives many of the details of the Allegheny series. It reports the **Lower Freeport coal** 2 feet thick, coming 598 feet below the Pittsburg bed. It also reports 5 feet of coal gum or bituminous material that probably represents the **Clarion coal**, coming 16 feet above the top of the great Homewood sandstone

2. Vol. I. p. 352, W. Va. Geol. Survey.

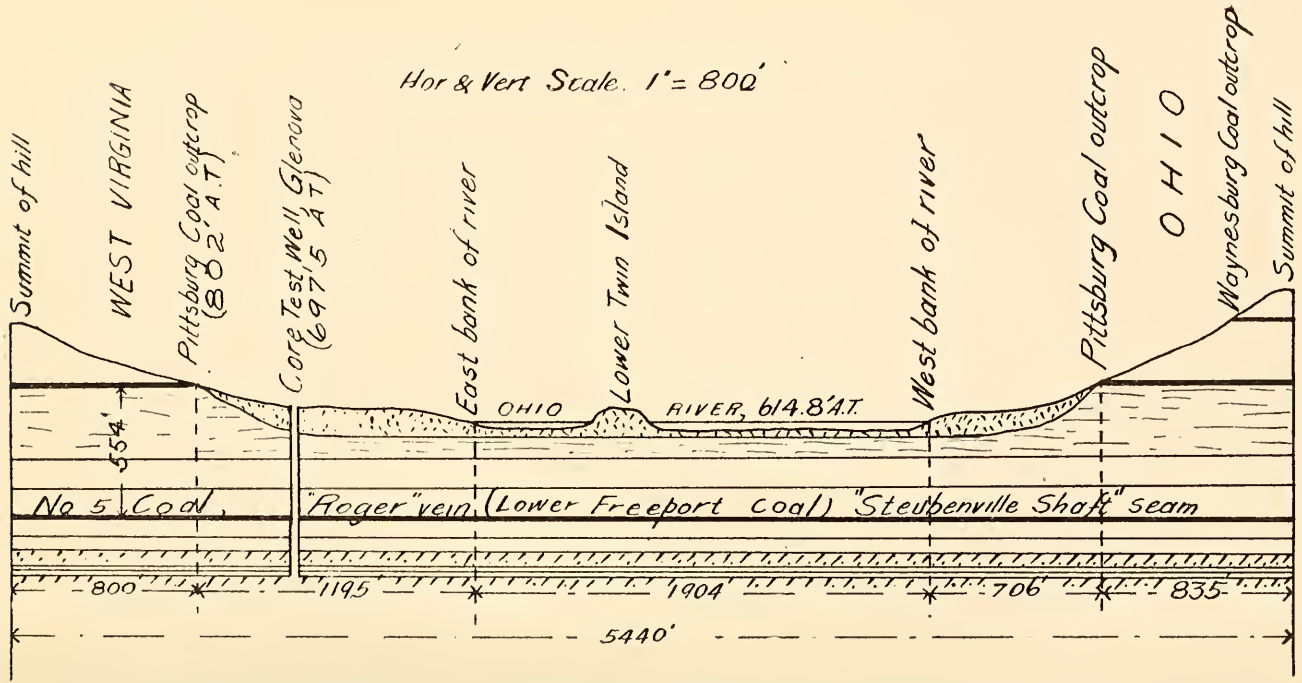

Fig. 2.—Cross-section of the Ohio River Valley at Glenova, Showing Outcropping and Underground Strata, 6½ Miles North From the Ohio-Marshall County Line.

(100′ thick), 27 feet below the Clarion sandstone (50′ thick), and 160 feet below the Lower Freeport coal. In Grant district, Wetzel county, the detailed log of the D. H. Cox No. 1 well (W 136), located on Upper run of Fishing creek, 2 miles north of Jacksonburg, reveals the complete absence of coal in the Allegheny series in this portion of Wetzel county. Likewise the detailed record of the Ed Wagner No. 1 well (W 299), located on Coal fork of Doolin run, 2½ miles northeast of New Martinsville, Magnolia district, Wetzel county, and published on page 273, reveals the absence of coal beds in either the Conemaugh or Allegheny series in this portion of Wetzel.

In Tyler county, the detailed log of the Moses Johnson No. 1 well (T229), published on page 118 in connection with the McKim section, shows a trace of coal that probably represents the **Lower Kittanning** bed, coming as it does 704 feet below the Pittsburg bed and 30 feet below the base of the great **Lower Freeport sandstone** (130 feet thick). This was the only trace of coal observed by the driller in the Allegheny series. On the head of Sancho creek, 3.1 miles northeast of McKim P. O., the South Penn Oil Co. put down a boring to the Big Injun sand on the B. L. Pyle farm (T 204). The record of this well is very complete and reveals the absence of any coal beds whatsoever. Its log as furnished the Survey by the South Penn Oil Co. is as follows:

B. L. Pyle No. 1 Well Record (T 204), Tyler County.

	Thickness Feet	Total Feet.
Unrecorded	18	18
Slate	40	58
White sand	15	73
Red rock	30	103
Dark sand	10	113
Slate	100	213
Red rock	25	238
Slate and lime	70	308
Slate	100	408
White sand	50	458
Red rock	30	488
Lime	25	513
Slate	100	613
Red rock	60	673

	Thickness Ft.	Total. Ft.
Slate	147	820
Gray sand	20	840
Slate and lime	30	870
Red rock	30	900
White sand	20	920
Slate	35	955
Red rock	20	975
Slate	50	1025
Red rock	35	1060
Dark sand	15	1075
Red rock	5	1080
Dark sand	20	1100
Slate	20	1120
White sand, Lower Freeport	50	1170
Slate	50	1220
Gray sand	20	1240
Lime	25	1265
Salt sand	175	1440
(Show black oil 1375′)		
Slate	50	1490
Lime	10	1500
Slate	90	1590
Lime	20	1610
Dark sand, **(Maxton)**	30	1640
Slate	20	1660
White sand	10	1670
Big Lime, **Greenbrier**	64	1734
Keener Sand	10	1744
Lime	5	1749
Big Injun	8	1827
Slate to bottom	78	1905
Flow of gas at 1825.		

The Pittsburg coal horizon should come at a depth of about 480 to 490 feet.

The detailed log of the W. W. Myers No. 1 well (T 137), published on page 114 for the Big run of Indian creek section, 5½ miles east of Middlebourne, gives the approximate thickness of the Allegheny series in this portion of Tyler as 255 feet. This record reports 4 feet of **Lower Freeport coal** coming 654 feet beow the Pittsburg bed and directly over the Lower Freeport sandstone (51 feet thick).

On Woodburn run of Indian creek, 2 miles northeast of Big Moses, Tyler county, the Tri-State Gas Co. drilled a well on the Elizabeth Stoneking farm (T 140). The record of this well was kept in detail and exhibits the following succession of strata:

Elizabeth Stoneking No. 1 Well Record, (T 140) Tyler County.

	Thickness Feet	Total Feet.
Conductor	0	12
Lime	78	90
Slate	25	115
Lime	40	155
Red rock	30	185
Sand	10	195
Slate	15	210
Lime	20	230
Slate	25	255
Lime	45	300
Slate	10	310
Lime	15	325
Slate	15	340
Sand	20	360
Slate	40	400
Slate and lime	60	460
Coal, Pittsburg	3	463
Lime	15	478
Slate	37	515
Sand, **(Connellsville)**	45	560
Slate	40	600
Lime	15	615
Red rock	10	625
Lime	15	640
Red rock	15	655
Lime	10	665
Red rock, (cave) "Big	55	720
Lime "Reds"	25	745
Red rock (cave)	60	805
Sand	5	810
Red rock	10	820
Sand	10	830
Slate	65	895
Sand, oil show, Dunkard	10	905
Unrecorded	45	950
Slate	10	960
Sand, **(Lower Mahoning)**	15	975
Slate	15	990
Lime	40	1030
Sand, **(Upper Freeport)**	40	1070
Coal, (Lower Freeport)	2	1072
Slate	128	1200
Salt sand	200	1400
Slate	45	1445
Slate	145	1590
Red rock	10	1600
Maxton Sand	30	1630
Limestone	20	1650
Slate	10	1660
Limestone	10	1670
Slate	15	1685
Big Lime. **Greenbrier Limestone**	85	1770
Big Injun Sand to gas and oil pay	70	1840

The Washington coal (2 to 3 feet thick) crops in the hill 15 feet above the top of the well, making its interval above the Pittsburg bed here 475 feet. The **Allegheny series** evidently extends from near 975 feet in depth to 1200 feet at the top of the Salt Sand, giving the series a thickness of about 225 feet in this portion of Tyler county. The driller reports 2 feet of **Lower Freeport coal** coming 607 feet below the Pittsburg bed. The former appears to be the only **coal** represented in the Allegheny series, and it is too thin to have any economic value. The Conemaugh series also appears barren of any coal. The Pittsburg coal is reported 3 feet thick, coming 1307 feet above the top of the Big Injun sand, the interval expected in this portion of Tyler county.

DESCRIPTION OF THE FORMATIONS.

The principal formations of the Allegheny series, or those that have received names, are as follows in descending order:

Upper Freeport Coal.
Upper Freeport Limestone.
Bolivar Fire Clay.
Upper Freeport Sandstone.
Lower Freeport Coal.
Lower Freeport Limestone.
Lower Freeport Sandstone (Second Cow Run Sand).
Upper Kittanning Coal.
Middle Kittanning Coal.
Lower Kittanning Coal.
Lower Kittanning Clay.
Lower Kittanning Sandstone.
Vanport (Ferriferous) Limestone.
Clarion Sandstone.
Clarion Coal.
Clarion Clay.

In the Marshall-Wetzel-Tyler area, all these formations lie deeply buried below drainage, and the only source of information as to the character of the individual beds are the records of oil and gas wells scattered over the three counties, since no

diamond drill boring, to the knowledge of the writer, has yet penetrated this series in the three counties. From all data it appears that the **Lower Freeport coal** is the only formation in the series of economic value in the entire area.

The Lower Freeport Coal.

At an interval of 40 to 100 feet below the top of the Allegheny series of rocks there generally occurs a coal horizon which has been named the **Lower Freeport coal** by the First Geological Survey of Pennsylvania, from the town of Freeport, Pa., on the Allegheny river. This coal is a multiple bedded seam at that type locality where it has the following detailed structure.

	Ft.	In.
Cannel slate	5	0
Slaty coal	4	0
Fire clay and limestone	2	6
Slaty coal	2	6
Total	14	0

Along the Ohio valley in the Panhandle region of West Virginia, this bed is locally known as the "Roger Vein" and "Steubenville Shaft Vein." Its horizon lies deeply buried below drainage at all points of the Marshall-Wetzell-Tyler area, but appears to be rather persistent and of fair thickness according to oil well records in Union, Washington, Sand Hill, and Webster districts of northern Marshall county. In the Glenova, W. Va. diamond drill boring on the Ohio river front, 6½ miles north from the Ohio-Marshall county line, a partial record of which is given on page 328 of this report, the **Lower Freeport coal** is there 3 feet 9 inches thick. Dr. I. C. White[3] has the following to say concerning the chemical composition of this coal in the Glenova boring, as well as in other portions of the Pan-Handle area:

"Owing to the fact that a 'blower' of natural gas was struck when the drill penetrated this coal bed at Glenova, only a portion of the core was secured, and that probably mostly from the

3. Introduction to Ohio-Brooke-Hancock Co. Report, W. Va. Geol. Survey.

bottom part of the bed which is always highest in sulphur. The analysis of the samples of the coal saved gave the following results as reported by Mr. Leicester Patton, the Assistant Chemist of the Survey:

Proximate Analysis.	Per cent.
Moisture	1.05
Volatile matter	36.00
Fixed carbon	54.86
Ash	8.09
	100.00

Ultimate Analysis.	Per cent.
Carbon	75.27
Hydrogen	5.56
Oxygen	7.22
Nitrogen	1.18
Suphur	2.68
Ash	8.09
	100.00

	Per cent.
Sulphur	2.68
Phosphorus	0.008
Calorific value:	
Calorimeter B. T. U.	13,819
Calculated B. T. U.	13,946

"This analysis indicates a fuel coal of great excellence, and if crushed and purified by modern methods would undoubtedly burn into an excellent quality of coke, since the sulphur would be much lower than in the sample analyzed, and then the physical appearance of the coal shows it to be of the coking variety. Where this coal is mined by shafts in the vicinity of Brilliant, Steubenville and other points above Wheeling, the bottom portion of the bed, 8 to 14 inches in thickness, is often rejected and frequently separated when mined, since it is high in sulphur, while the average in the coal above the bottom member is usually less than one per cent. A thin parting of slate generally separates the bottom member from the main portion of the seam above so that the upper and purer portion of this coal can be readily mined independent of the basal division. This is done at Brilliant, Ohio, just opposite Wellsburg, 14 miles above Glenova, where the Lower Freeport coal is mined by means of shafts 200 feet and more in depth, and has an average thickness of 3 feet 9 inches, the same as found in the Glenova boring. At Steubenville, the LaBelle Iron Company is reported as using 2,000 to 2,500 tons of this coal daily for steam and gas producer purposes, the average thickness being 42 inches, of which the lower eight

inches is rejected for the gas producer as being too high in sulphur. At the Steubenville Coal & Mining Company's shaft, the bed varies in thickness from 51 inches to 58 inches, and the bottom sulphurous coal has a thickness of 14 inches. The thickness of this coal at Steubenville is given on the authority of Mr. W. T. Griswold, as published on page* 236 of this report. Both of these companies obtain the most of their coal from Brooke county, West Virginia, through galleries under the Ohio river, 100 feet or more below its bed."

The Lower Freeport coal has been reported in wells drilled for oil and gas near Moundsville. The log of the S. T. Alley No. 1 well at Majorsville on Wheeling creek, Marshall county, reports this coal 3 feet thick, coming 587 feet below the Pittsburg bed. About 6 or 7 miles southwest of this point, the log of the J. T. Cox No. 1 well (M 24) reports this coal 5 feet thick, coming 615 feet below the Pittsburg bed.

The Lower Freeport coal seems to thin out and disappear in southern Marshall and in Wetzel and Tyler counties.

The **Pottsville, Mauch Chunk,** and **Pocono** groups of rocks, as well as the **Devonian** system, all lie deeply buried below drainage in the Marshall-Wetzel-Tyler area, but all are of geologic interest on account of their contained oil and gas producing sands. The description of the latter beds will be taken up in the chapter on oil and gas.

---

* Referring to page 236 of quoted report.

PART III.

The Mineral Resources of the Marshall-Wetzel-Tyler Area.

CHAPTER VIII.

PETROLEUM AND NATURAL GAS IN MARSHALL, WETZEL AND TYLER COUNTIES.

In West Virginia all the oil and gas yet discovered has been produced from sandstone beds, called "sands" by the drillers. Various names have been given these sands by the oil fraternity, and these terms have gradually come into general usage in describing the beds. The following table by Dr. I. C. White[1] with some modifications by the writer will show the position of the various sands in the geologic column:

The Oil and Gas Horizons of West Virginia.

Carboniferous.	Monongahela Series.	Carroll Sand.
	Conemaugh Series	Murphy (Morgantown). First Cow Run sand (Saltzburg) or Moundsville. Upper and Lower Dunkard sands (Mahoning).
	Allegheny Series	Gas Sand (Lower Freeport).
	Pottsville Series	Gas sand of Marion and Monongalia counties (Homewood). Second Cow Run sand. Gas sand of Cairo. Salt sand, Cairo. Cairo?
	Mauch Chunk Red Shale	Maxton, Dawson, Cairo?

[1]Vol. I (a), p. 506, W. Va. Geol. Survey.

Greenbrier Limestone "Big Lime," not productive.

Devonian.

Pocono Sandstone
- Keener sand and Beckett sand of Milton.
- Big Injun sand.
- Squaw sand.
- Berea Grit.

Catskill Red Beds
- Gantz sand.
- Fifty-foot sand.
- Thirty-foot sand.
- Stray sand.
- Gordon sand.
- Fourth sand.
- McDonald or Fifth sand.
- Bayard or Sixth sand.

Chemung, Hamilton and Corniferous Beds
- Warren First? or Second?, Tiona? Speechley sand? No well defined oil or gas horizons yet discovered in West Virginia.

In the Marshall-Wetzel-Tyler area oil and gas in paying quantities are found at several horizons, as given in the above table except the Murphy, Squaw, Berea Grit, Gantz, and Bayard or Sixth sands. The Big Injun, Gordon, and Salt sands appear to be the most persistent over the area, and the others may be considered more or less lentil in character. The Pittsburg coal underlies much the larger portion of the 3 counties and as mentioned heretofore is largely used as the **key rock** to determine the position of the oil and gas bearing strata.

In order to get a general idea of the sequence or order of the beds. the following table is given to show the approximate distance from the Pittsburg coal to the top of the different sands:

Approximate Distances from top of Pittsburg Coal to Top of Oil And Gas Sands in Marshall, Wetzel, and Tyler Counties.

SAND	Distance Feet	SAND	Distance Feet
Murphy (Morgantown) sand	200	Berea Grit	1730
1st Cow Run (Saltsburg) sand	325	First Sand or Gantz	1850
Dunkard (Mahoning) sand	450	Fifty-foot	1900
Gas sand (Lower Freeport)	625	Thirty-foot	2000
2nd Cow Run or Gas Sand (Homewood)	750	Gordon Stray	2040
Salt Sand	900	Gordon	2075
Maxton, Dawson Sand	1075	Fourth	2150
Keener Sand	1180	McDonald or Fifth	2225
Big Injun Sand	1200	Bayard, or Sixth	2350
Squaw Sand	1400	Speechley?, Warren I or II?, Tiona?	2675

Owing to the rapid thinning of the measures to the northwest, the above intervals are only approximate. For example, the interval from the top of the Pittsburg coal to the top of the Big Injun sand in the Lem Leach No. 1 well (M 12) near Limestone P. O. in northwest Marshall county is 1045 feet as opposed to 1335 feet for the same interval in the M. W. Spencer No. 1 well (T 135), located 1 mile northwest of Big Moses P. O. in eastern Tyler county, giving a total convergence of 290 feet for these 2 formations in the 35 miles northward, or at the rate of 8.3 feet to the mile. Thus it is readily seen that no specific figures for intervals for any sand below the top of the Pittsburg coal can possibly hold good over the entire area of the 3 counties.

DESCRIPTION OF SANDS.

The Murphy Sand.

At 175 to 225 feet below the Pittsburg coal there often occurs an oil bearing sand that corresponds to the Morgantown sandstone, receiving the latter name from the city of Morgantown, Monongalia county, W. Va., where it crops about half way up the hill sides. According to Dr. I. C. White[2] it is the "Shallow Oil Sand" at the mouth of Island run, Ritchie county, W. Va. and at Deem's Ferry, below the California House, in the same county, and it has also produced oil on Dunkard creek, Greene county, Pa., and for that reason is sometimes called the **Little Dunkard** sand.

Along the Ohio river front about 1 mile south of the mouth of Grave creek at Moundsville, Marshall county, Mr. M. Callahan of the latter place drilled 2 or 3 wells in one of which oil was found at a depth of 287 feet, coming 135 feet below the Pittsburg coal. This would appear to represent the Morgantown (Murphy sand) horizon,and not the **First Cow Run** as given by Mr. Callahan. This is the only point in the 3 counties known to the writer that oil or gas in paying quantities has been produced from the Murphy sand.

[2]Vol. I (a), p. 77, W. Va. Geol. Survey.

First Cow Run Sand.

At 300 to 375 feet below the Pittsburg coal occurs an oil producing stratum that has been named by the oil well drillers the **First Cow Run Sand** from a stream of that name in Washington county, Ohio, where it comes 300 to 315 feet below the Pittsburg coal. Allowing for the northwestward thinning of the measures, this would make this formation correspond to the **Saltsburg sandstone** of the Conemaugh series.

On Little Grave creek, 2 miles northeast from Moundsville, occurs quite a prolific pool of oil from this sand, coming as it does 300 to 310 feet below the Pittsburg coal. The oil from this sand at that locality is almost refined as it comes from the ground. Dr. I. C. White[3] has the following to say concerning this oil and pool:

"There are now (March 5th[4]) about 30 wells producing from this sand and the yield is 100 barrels daily. The oil is peculiar in being lighter in gravity than any petroleum ever discovered, gauging 63°.5 B. after reaching the pipe line tanks. The only approach to this is the oil from probably the same sand in the Big Flint district of Doddridge county, which scaled 63° according to Mr. Wm. A. Earseman of the South Penn Oil Company."

The Little Grave creek region is the only point in Marshall where oil has been found in paying quantities in the First Cow Run.

In Wetzel county the First Cow Run sand has produced oil in the Margaret Gump[5] well No. 1 in the Smithfield region where it comes 334 feet below the Pittsburg coal. In the Folsom field of the same county a 20-barrel well was struck in this sand by the South Penn Oil Company on the S. H. Davis farm the top of the sand there coming 356 feet below the Pittsburg coal. The driller identified it as the Little Dunkard sand, but it really belongs 100 feet higher up in the meas-

3. Vol. I, p. 364.
4. March 5th, 1899.
5. Vol. I (a), p. 187 W. Va. Geological Survey.

ure at the Saltsburg sandstone horizon, therefore correlating with the First Cow Run sand.

In Union and Meade districts, Tyler county, however, are found a large number of fair oil wells from this sand. In the former district, a narrow belt of Cow Run sand oil wells extends 3 miles to the northeast from the head of Bens run or the Tyler-Pleasants county line. In Meade district, Tyler, several fine oil wells are found in this sand on McKim creek on the Poe, Broadwater, and other farms northwest, west, and southwest of McKim P. O. In this region the sand ranges from 25 to 50 feet in thickness, coming 250 to 300 feet below the Pittsburg coal and 25 to 30 under the "Big Reds". The initial production of the wells ranges from 4 to 5 barrels per day to over 150 barrels in some cases.

The Dunkard Sand.

According to the identifications of the drillers in the Marshall-Wetzel-Tyler area, the **Dunkard sand** may occur at any point from 300 to 600 feet below the Pittsburg coal, and its thickness ranges from 40 to over 100 feet. It received its name from Dunkard creek, Greene county, Pa., near the mouth of which some wells produced oil from this sand in 1863, where it corresponds to the Buffalo and Mahoning sandstones. In the western part of Greene County, Pa., a small break occurs in this sand and the upper division is called the Little Dunkard and the lower Division the Big Dunkard. Hence, the true horizon of the Dunkard sand is near 425 to 475 feet below the Pittsburg coal, and the term **Dunkard sand** is frequently wrongly applied to the First Cow Run sand.

In Marshall county, Mr. M. Callahan of Moundsville, W. Va., drilled 2 or 3 wells along the Ohio river front, just south of the mouth of Grave creek, in one of which he struck oil in a sand at a depth of 469 feet below the Pittsburg coal, which he wrongly termed the **Second Cow Run sand**. Its horizon would correspond to the Mahoning sandstone of the Conemaugh series, or the **Dunkard sand** of the oil producing series. The writer collected a sample of the oil from this sand in this well

from a stock tank in which it was mixed with **Murphy sand** oil from another well near by, and the mixture of the two tested 47½° Baume. In the Sistersville region, this sand is frequently wrongly identified by the drillers with one of the **Cow Run** sands, coming as it does 430 feet below the Pittsburg coal.

This sand has produced oil at 2 or 3 scattered wells in Wetzel county. The David Hostutler No. 1 well (W 10A) located near the head of Left fork of Cappo run, 2¾ miles northeast of Hundred, Grant district, Wetzel county, is a 25 to 30 barrel (initial production) per day **Dunkard sand** oil well. The writer collected a sample of this oil fresh from the tank that tested 51° Baume. In this well the sand was 24 feet thick, coming 478 feet below the Pittsburg coal. Another fair well was struck in this sand on the D. B. Ice farm (W 164) near the head of Fallen Timber run, one mile and a half south of Mobley P. O., Grant district, Wetzel county.

One mile southeast of Shirley, Tyler county, occur 2 or 3 small Dunkard sand wells. The sand there is 20 to 30 feet thick, coming 435 feet below the Pittsburg coal.

The Gas Sand.

The term **Gas sand** is frequently applied to a gaseous stratum in some counties of W. Va., coming near 600 to 650 feet below the Pittsburg coal. This corresponds to the horizon of the Lower Freeport sandstone of the Allegheny series. It is not of much importance in the area under discussion and no paying wells have been reported from this sand in the 3 counties.

The Second Cow Run Sand.

In the old Cow run development of Washington county, Ohio, according to Prof. J. A. Bownocker[6] the top of the **Second Cow Run sand**, designated from a stream of that name in the same county, comes 451 feet below the top of the **First Cow Run sand**, and 765 feet below the top of the

[6]Bulletin No. 1, pp. 168 and 169, Ohio Geol. Survey.

Pittsburg coal. On Wheeling creek in northern Marshall county, W. Va., several small gas wells have been struck in a sand that appears to represent the true **Second Cow Run,** coming as it does from 725 to 765 feet below the Pittsburg coal. It appears to correlate with the **Homewood sandstone** at the top of the Pottsville series. It may possibly correspond to the Clarion sand at the base of the Allegheny series, but the evidence is slightly in favor of the former identification. Its recorded thickness ranges from 25 to over 150 feet in some parts of the area. Its variation in thickness, however, may possibly be due to the tendency of drillers to class everything as sandstone for some distance, when in reality several layers of shale beds may come in between. Outside of the Wheeling creek district of Marshall county, this sand, so far as known to the writer, does not produce either oil or gas in paying quantities in any other portion of the area under discussion.

The Salt Sand.

The "Salt sand" of the drillers in West Virginia constitutes the main portion of the Pottsville series of rocks, and often consists of three or four distinct sandstones separated by shales containing thin coal beds. The sand has been so named by the oil fraternity on account of the **salt water** often encountered in drilling through it. It is an important oil and gas horizon at several points in West Virginia. The "Yellow Creek" and "Steer Creek" fields of Calhoun county; the "Flat Fork" field of Roane; the "Volcano" field of Wood and Ritchie; and the "Burning Springs" field of Wirt, all produce considerable oil or gas in paying quantities from this series. One of the upper members of this group is often called the "Gas sand" by the drillers.

In the Marshal-Wetzel-Tyler area the **Salt sand** ranges in thickness from 50 to 250 feet, coming about 900 feet below the Pittsburg coal. When the drillers' log gives much over 100 feet for the thickness of the Salt sand, the Gas sand is not generally noted, showing that the two have probably coalesced. This sand produces gas in northeastern Marshall County, W.

Va., at Majorsville, where it is reported in the S. T. Alley No. 1 well to be 160 feet thick, coming 860 feet below the Pittsburg coal.

In the **Cameron field,** Liberty district, Marshall, the Gartland Heirs No. 1 well (M 65), located near the head of Big run, produces gas from the Salt sand and is reported the only well in the field from this sand, the other wells in this vicinity producing gas from the Big Injun, Gordon Stray, and Gordon sands.

So far as known to the writer this stratum has never produced **oil** in paying quantities in Wetzel county, but in Clay and Grant districts, Wetzel, are found several scattered wells that produce **gas** from this horizon, their location being readily noted by a glance at the tabulated list of oil wells for Wetzel given on a subsequent page of this report.

In Union district, Tyler county, a small **Salt sand** well is found on the Addie Knowlton farm (T. 65), located near the head of Stewart run of Middle Island creek, 1 mile east of Bowles Mills (Little P. O.). In this well the top of the sand comes about 825 feet below the horizon of the Pittsburg coal. This is the only paying well for either oil or gas in this sand found by the writer in Tyler county.

The Maxton Sand.

In the Marshall-Wetzel-Tyler area a sandy horizon occurs about midway in the **Mauch Chunk series** that has been named by the drillers the **Maxton sand.** It ranges from 10 to even 80 feet in thickness in the Burton, Wetzel county, field. Its base comes immediately over the "Pencil cave" at the top of **Big lime,** coming about 1070 to 1100 feet below the top of the Pittsburg coal. It corresponds to the **Salvation sand** of Greene county, Pa., where it lies above the Big lime, being separated from it only by the "Pencil cave," and produces gas from a few wells in Springhill township. It may correspond to the **Dawson sand** near Middlebourne, but the latter seems to be a part of the Big lime itself. The **red shales** of the **Mauch Chunk** thin away

westward in Tyler county and at the Ohio river let the Pottsville beds above rest immediately upon the Big Lime.

This sand does not appear as a paying oil and gas horizon in Marshall county, but has proved very prolific in both oil and gas in Church district, Wetzel county, and at a few scattered wells in Center, Grant, and Green districts, the same county. Probably the best Maxton sand pool ever opened up, consisting of 35 to 40 wells, is the field located on the head of Church fork of Fishing creek, ¾ mile northeast of Burton, Church district, Wetzel. The initial production of the wells ranged from 10 to 100 bbls. daily, giving an amber colored oil, two samples of which tested by the writer registered 43½° and 44° Baume. The wells hold up well and compare favorably in this respect to Big Injun and Gordon sand production.

In Green district, Wetzel, the Wendell Oil Co. of New Martinsville, W. Va., brought in a small Maxton sand oil well during 1908, on the Sam'l Abrigg farm (W 263), located 1 mile northeast of Porters Falls. The sand here was 22½ feet thick, coming 1067 feet below the top of the Pittsburg coal also noted in the well.

In Tyler county this sand produces a great deal of oil. The **Dawson sand** of the Middlebourne region most probably represents the **Maxton sand,** coming as it does in immediate contact with the **Big Lime (Greenbrier limestone)** below, the separating shales and "Pencil cave" having been entirely eroded in the deposition of the overlying Dawson sand. The records of these wells appear on subsequent pages of this report as well as a tabulated list of over 260 scattered wells in Tyler county, and the producing sand at this horizon in the vicinity of Middlebourne is there listed as "Dawson" instead of "Maxton." In Tyler county this sand attains a thickness of 50 feet and the initial production of some of the wells reaches almost 100 barrels of oil per day.

The Big Injun Sand.

The **Big Injun sand** is the easiest stratum to identify by the oil well driller in the Marshall-Wetzel-Tyler area, coming as it does directly under the **Big lime (Greenbrier limestone).** It

varies from 100 to 300 feet in thickness. In Magnolia district, Wetzel, and the western half of Tyler county, the upper portion, 15 to 40 feet thick called the **Keener sand,** is separated from the main bed by a break of slate. Dr. I. C. White has the following to say concerning the Big Injun[7] oil sand:

"***** the **Big Injun" oil sand** of the drillers, a hard and often fine-grained gray sandstone, with usually two, and occasionally, three or four open, coarse, and porous, sometimes pebbly layers, filled with oil, gas, or salt water, called **"pay" streaks** by the drillers; in Monongalia, Marion, and eastern Wetzel counties often unbroken by slate from top to bottom, and usually 140 to 150 feet thick, with a **gas "pay"** at 15 to 20 feet in the rock; the **1st oil 'pay'** at 60 to 75 feet; the **2nd** or main one at 80 to 90 feet; and often a **3rd** at 100 to 110 feet below the top of the sand. In Tyler, Pleasants, Ritchie, and other counties, the uppermost 20 to 30 feet of the "Big Injun" of Monongalia, Marion and Wetzel, usually separated from the main body of the rock by from 5 to 15 feet of dark slate, is then called the **Keener sand,** and becomes an important oil and gas zone in the counties mentioned, though in Monongalia, Marion and eastern Wetzel nothing but **gas** has ever been found at this horizon, the main body of the "Big Injun" oil of these counties occurring at 75 to 90 feet below the top of the sand."

The lowermost 20 to 30 feet of the Big Injun sand is often separated from the main bed by 20 to 40 feet of dark sandy shales. This division is known by the drillers as the **Squaw sand** and so far as known to the writer is unproductive of either oil or gas in Marshall, Wetzel, and Tyler counties.

In Marshall county there is a small production of Big Injun sand oil. On Wheeling creek in the vicinity of Majorsville the S. T. Alley No. 3 well (M 25) produced 4 to 5 barrels of oil per day from this sand and is the only oil well from any horizon in the field. About 4 years ago the Hope Natural Gas Co. drilled in a small Big Injun sand well in the northwest corner of Liberty district, Marshall County, located ½ mile south of a point on Grave creek, about midway between Glen Easton and

[7]Vol. I (a), p. 79, W. Va. Geol. Survey.

Loudenville on the Elijah Williams farm (M 40). This well was drilled nearly 4 years ago and produced about 500 barrels of oil before it was finally abandoned. In Franklin district in the southwest portion of Marshall, a few small producing oil wells in this sand are found near the head of Sims run. In the extreme southwest corner of Marshall county are found a few light Big Injun sand wells. This sand also produces gas in one or two wells in Liberty district on Fourmile run north from Bellton (Denver Sta.).

The Big Injun sand, along with the Gordon, is the great oil and gas horizon of Wetzel and Tyler, and these two counties have probably produced more oil than any other two counties in the State.

In Church district, Wetzel county, it is the great gas horizon southeast of Hundred. It is also a great oil horizon in the vicinity of Mobley, Pricetown, Smithfield, and Jacksonburg, Grant district, Wetzel, as well as at Piney and southwest of Reader in Greene district, the same county. There is also a small Big Injun sand oil pool on Little Fishing creek near Maud P. O. in the extreme southwest corner of Proctor district, Wetzel county. In Magnolia district, the same county, there are 2 or 3 light oil wells in the Keener portion of the Big Injun sand.

In Tyler county, the Keener and Big Injun sands have been by far the most prolific oil and gas horizons. The oil wells of the Little Pittsburg, Big Moses, and Wick fields are mostly in the Big Injun sand, while the Elk Fork, and Bowles Mills fields are in the Keener sand, as well as the southwest portion of the Sistersville field. The major portion of the latter field, however, is in the Big Injun sand proper.

The following table, giving the minimum, maximum, and average interval in feet from the top of the Pittsburg coal to the top of the Big Injun sand, including the Keener division, as revealed by 2 wells in each district of each county is of special interest in that it shows a great thinning of the intervening measures taking place in passing from the eastern districts to those bordering on the Ohio river in the three counties:

Distances From the Top of the Pittsburg Coal to Big Injun Sand In the Marshall-Wetzel-Tyler Area.

District	County.	Feet. Minimum	Feet. Maximum	Feet. Average
Union	Marshall	....	....	....
Sand Hill ..	"	1090	1131	1110
Webster	"	1039	1195	1117
Washington..	"	1045	1045	1045
Cameron	"	1122	1160	1141
Clay	"	1058	1125	1091
Liberty	"	1095	1250	1172
Meade	"	1085	1200	1142
Franklin	"	1101	1117	1109
Grant	Wetzel	1186	1355	1270
Proctor	"	1085	1209	1147
Church	"	1182	1285	1233
Clay	"	1238	1290	1264
Green	"	1217	1327	1272
Center	"	1198	1295	1246
Magnolia ...	"	1120	1182	1151
Lincoln	Tyler	1158	1217	1187
Union	"	1150	1207	1178
Ellsworth ...	"	1130	1294	1212
McElroy	"	1256	1350	1303
Centerville ..	"	1250	1305	1277
Meade	"	1210	1313	1261

The Berea Grit Sand.

The first sand generally to be recognized by the drillers below the Big Injun sand is the **Berea Grit,** coming 1730 to 1750 feet below the Pittsburg coal and about 200 feet below the base of the Big Injun sand. It ranges from 25 to 30 feet thick and produces both oil and gas in Brooke, Hancock, Pleasants, Wood, Wirt, Ritchie, Calhoun, and Cabell counties, but does not produce either in paying quantities in the Marshall-Wetzel-Tyler area. In fact, in this area its horizon is rather difficult to recognize. The detailed log of the Sarah Anderson No. 1 well (W 1), published on page 110 in connection with the Burton section, reports 15 feet of **sand,** coming 1776 feet below the Pittsburg coal and 285 feet below the base of the Big Injun sand, that appears to correlate with the **Berea.**

According to R. W. Stone and F. G. Clapp[8] the "30-foot" sand of Greene county, Pa., correlates with the Berea. In their

8. Bulletin To. 304, U. S. Geol. Survey.

report on the latter county they have the following to say concerning the **Thirty-foot sand:**

"****** In this county the Thirty-foot sand is not the same as the Thirty-foot in Butler and Armstrong counties, but probably corresponds with what is sometimes known as the Gas, Butler, or Murrysville sand. It agrees closely with the **Berea** sand of Beaver county, Pa., Jefferson county, Ohio, and Brooke county, W. Va. It is sometimes difficult to decide whether a sand noted as Thirty-foot in well records is in reality the Thirty-foot, Gantz or some local sand, but this question can generally be answered by noting the positions of the red beds encountered by the drill. Between the Thirty-foot and Gantz sands lies a thin bed of **red shale** which is found in the wells of Washington county and generally in western Greene county, and which has been provisionally correlated with the Bedford shale of Ohio. The next lower red occurs 100 to 200 feet deeper, at the horizon of the Nineveh sand."

The Gantz Sand.

The next oil and gas horizon below the Berea is the **Gantz sand,** coming 1850 to 1950 feet below the Pittsburg coal. It takes its name from a well on the Gantz farm at Washington, Pa. that was drilled in the year 1885[9] and is reported to be the first paying oil well in Washington county, Pa. At this well it comes 1827 feet below the Pittsburg coal, the interval being much less than in Greene county, Pa., and eastern Marshall and Wetzel counties on account of the disappearance of the Mauch Chunk shale to the northwest. In Greene county, Pa., this sand is usually 10 to 25 feet thick. The log of the Sarah Anderson No. 1 well (W 1), published on page 110 in connection with the Burton, Wetzel county section reports the Gantz sand 10 feet thick, coming 1951 feet below the top of the Pittsburg coal, 160 feet below the base of the Berea sand and 34 feet below 15 feet of pink rock, the latter no doubt correlating with the **red shale** generally found in the interval between the **Gantz** and **Berea** sands in Washington county, Pa. The Gantz sand is the top

9. Bulletin No. 304, U. S. Geol. Survey.

portion of the **Hundred-foot sand** of Butler county, Pa. So far as known to the writer there are no paying wells in the Gantz sand in the Marshall-Wetzel-Tyler area, except the famous "Hoodoo well 10" or L. G. Robinson No. 1 near Folsom, Wetzel county, in which a 5-barrel per day showing was reported in the Gantz sand, the top of the latter coming 260 feet above the Gordon sand.

The Fifty-Foot Sand.

The **Fifty-foot sand** closely underlies the Gantz sand, the two combining often into one great sand known as the **Hundred-foot** of Butler, Armstrong, and Beaver counties, Penna. Its interval below the Pittsburg coal varies from 1900 to 1975 in the Marshall-Wetzel-Tyler area. According to Stone & Clapp[11] the interval between the top of the Big Injun sand and the Fifty-foot sand in Greene county, Pa., increases from south to north, while the Pittsburg coal-Big Injun sand interval decreases in the same direction. In other words, the southward thinning of the rocks below the Mauch Chunk about compensates for the northward thinning of the Mauch Chunk and rocks above the Big Injun sand. The detailed log of the Sarah Anderson No. 1 well (W 1), published on page 110 shows this sand with its alternate layers of slate to be 51 feet thick, coming 1966 feet below the top of the Pittsburg coal and 5 feet below the Gantz sand. The Fifty-foot sand does not appear to produce oil or gas in paying quantities in the 3 counties. In Church district, Wetzel county, the Carnegie Natural Gas Co. put down a well on the Mary Hunt farm (W 40) at the mouth of Rockcamp run in which it got a fair gas well in the Fifty-foot sand. This is the only well known to the writer in the entire area that produces either oil or gas in paying quantities.

The Thirty-Foot Sand.

The next oil and gas producing horizon below the Fifty-foot sand in the Marshall-Wetzel-Tyler area is what is known

10. The Oil Well Driller—C. A. Whiteshot, p. 73.
11. Bulletin No. 304, U. S. Geol. Survey.

as the **Thirty-foot sand** by the drillers coming about 2000 feet below the top of the Pittsburg coal and immediately over **red beds** that separate it from the Gordon group below. It may possibly correlate with the **Nineveh sand** of Greene county Pa., the latter being identified by R. W. Stone and F. C. Clapp[12] as the main oil horizon in the New Freeport and Bristoria fields in the latter county. If so, its average interval there below the Pittsburg coal appears to be about 50 to 75 feet greater than in northern Church district, Wetzel county, W. Va., adjoining Springhill township, Greene county, Pa., on the south. In other words, the **Gordon sand** of Church district, Wetzel county appears to be the same as the **Nineveh sand** of Greene county. The records of the W. H. Himelrick No. 1 well (W 14) and Wm. Renner No. 1 well (W 10), near where the Nineveh sand oil pool crosses the Penna-W. Va. state line, published on a subsequent page of this report, show the Gordon sand coming 2100 and 2110 feet respectively below the top of the Pittsburg coal, and the intervals for the **Thirty-foot sand** with **red rock** underneath below the same horizon are 1975 and 2000 feet respectively. The detailed log of the Sarah Anderson No. 1 well (W 1) in Church district, Wetzel county, located about 2 miles east of the town of Hundred, published on page 110, with the Burton section, shows the Thirty-foot sand 35 feet thick, coming directly over 3 feet of **pink sand,** and 2025 feet below the top of the Pittsburg coal.

The Thirty-foot sand does not produce oil or gas in paying quantities in either Marshall or Tyler counties. In Church district, Wetzel county, the Carter Oil Co. drilled a well on the Sol Shriver farm (W 30) about 6 or 7 years ago, located 2 miles southeast of Burton station in which a light showing of oil (about 2 barrels per day) was struck in the Thirty-foot. The thickness of this sand here, as reported by the driller, is 32 feet, coming 1961 feet below the top of the Pittsburg coal. While its horizon is generally noted in the logs of the many Wetzel county wells, this is the only point known to the writer where it produces oil or gas in the area under discussion.

12. Bulletin 304, p. 37, U. S Geol. Survey.

The Gordon Stray Sand.

The **Gordon Stray sand** comes a short distance below the **red shale** separating it from the Thirty-foot sand above, and is generally separated from the true Gordon below at distances varying from 5 to 40 feet. It may be a split from the Gordon or possibly a new sand. In the Marshall-Wetzel-Tyler area it has been a very prolific horizon for both oil and gas, especially in Wetzel. Most of the oil production of the Steels run field northeast of Wileyville comes from this sand. It appears to be the great gas horizon along the crest of the Littleton anticline in Center and Grant districts, as well as in the vicinity of Pine Grove, Wetzel county. Gas is found at this horizon at a few scattered wells in Meade and Liberty districts, Marshall county.

The Gordon Sand.

The **Gordon sand** lies next in descending order below the Gordon Stray, and ranges in thickness from 5 to 35 feet in the Marshall-Wetzel-Tyler area where it has been a large producer of both oil and gas in all these counties. In the latter area its interval below the top of the Pittsburg coal is shown in the following table by districts in each county. Three districts in Marshall and four in Tyler are left blank in this table for the reason no drillings within their areas have certainly encountered the Gordon sand:

Distances from the Top of the Pittsburg Coal to the Gordon Sand in the Marshall-Wetzel-Tyler Area.

District	County.	Minimum Feet.	Maximum Feet.	Average Feet.
Union	Marshall	....	....	....
Sand Hill....	"	1959	1959	1959
Webster	"	....	....	....
Washington .	"	1895	2004	1949
Cameron	"	2004	2004	2004
Clay	"	....	....	....
Liberty	"	1975	2130	2052
Meade	"	1982	2024	2003
Franklin	"	1998	1999	1998
Grant	Wetzel	2050	2128	2089
Proctor	"	1990	2054	2022
Church	"	2033	2150	2091
Clay	"	2037	2113	2075
Green	"	2055	2118	2086
Center	"	2019	2086	2052
Magnolia ...	"	1950	1950	1950
Lincoln	Tyler	....	....	....
Union	"	....	....	....
Ellsworth ...	"	2069	2069	2069
McElroy	"	2040	2086	2063
Centerville ..	"	....	....	....
Meade	"	....	....	....

In Marshall county, a Gordon sand oil pool extends from ½ mile west of Cameron, southwest, crossing Fish creek just below the mouth of Valley run, and the Marshall-Wetzel county line just east of its intersection with Whetstone run. From this point it extends on southwest in Wetzel county and finally dies out just before reaching Proctor creek. The length of this field is nearly 14 miles, and it maintains an average width of from ½ to 1 mile. To the west of this belt in both Marshall and Wetzel counties, there occurs a large number of fine Gordon sand gas wells along the crest of the New Martinsville anticline.

In Wetzel county, it is the great oil horizon from ½ mile south of Dean P. O. on the head of Miller fork of Rocky run on southwestward through Dakon, Onie, Hoyt, Keough, and Mohr (Barker) post offices to Pine Grove. It is also a great oil horizon in the Jacksonburg region, and on the head of Piney fork and near the head of Buffalo run. There

is also quite a large Gordon sand pool in the extreme southeastern point of Grant district, Wetzel county.

The Stringtown oil field of eastern Tyler county is largely in this sand. With the exception of a few scattered gas wells on the waters of Indian and McElroy creeks, this is the only portion of Tyler county in which the Gordon sand produces oil or gas.

The Fourth Sand.

The next oil and gas bearing horizon below the Gordon sand is known by the drillers as the **Fourth sand.** It is often mistaken for the Gordon and is generally reported by drillers from 2150 to 2225 feet below the top of the Pittsburg coal, or from 20 to 100 feet below the top of the Gordon sand. Its thickness ranges from 8 to 50 feet. The occasional running together of this sand, the Gordon, and Gordon stray causes the three sometimes to be classed as the **Gordon group.**

In Marshall county, the oil pool at Bellton (Denver Sta.) is in the Fourth sand, coming slightly over 2100 feet below the Pittsburg coal and about 40 feet below the top of the Gordon sand.

In the extreme northeast corner of Church district, Wetzel county, there occurs a fine oil pool in the Fourth sand. In this region it comes 2150 to 2190 feet below the Pittsburg coal. A great gusher was struck in the Fourth sand in July, 1904, on the Sarah Anderson farm (W 1). This well is located on Church fork, nearly 2 miles east of Hundred, Wetzel county, and made 50 barrels of oil per hour for the first 24 hours from this horizon. The sand was reported by the driller to be 44 feet in thickness, coming 2188 feet below the top of the Pittsburg coal and 93 feet below the top of the Gordon sand.

There are several oil and gas wells near Littleton, Clay district, Wetzel county, in the Fourth sand where it comes 2170 feet below the Pittsburg coal.

There are no producing wells in this sand in Tyler county.

The Fifth Sand.

The next oil and gas horizon below the Fourth sand is what is known by the drillers as the **Fifth,** or **McDonald sand.** It is the great gas horizon of eastern Greene county, Pa., bordering the Marshall-Wetzel-Tyler area on the northeast. In the eastern portion of the latter area this sand lies 2225 to 2300 feet below the Pittsburg coal, and ranges from 5 to 20 feet in thickness. While its horizon is recognized by the drillers in many wells in Wetzel county, it has not there produced oil or gas in paying quantities. It is also unproductive in Tyler county.

In Marshall county the Fifth sand has produced oil in the Marshall County Bank (H. S. White) No. 1 well (M 121), located on Harts run, ½ mile north of Bellton (Denver Sta.). The initial production was 4 to 5 barrels of oil per day. The thickness of sand is reported at 8 feet, coming 2145 feet below the Pittsburg coal. One mile and a quarter southwest of this well gas was struck in this sand in the J. L. Hoffman No. 1 well (M 119), located on the south bank of Fish creek. In this well the sand was reported only 3 feet thick, coming 2127 feet below the Pittsburg coal. In both these wells the **Thirty-foot, red rock, Gordon Stray, Gordon and Fourth** sands were recognized at their proper horizons, and the 100 feet less interval from that in eastern Wetzel county is caused by rapid northwest thinning of the intervening beds.

The Bayard or Sixth Sand.

The **Bayard sand** took its name from the farm of Thomas Bayard, located 4 miles southeast of Waynesburg, Greene county, Pa., where it was reported 10 feet thick, coming 2417 feet below the Pittsburg coal, and 70 feet below the top of the Fifth sand. It is also the splendid oil producing sand in the vicinity of Fairview, Marion county, W. Va., where it comes 2410 feet below the Pittsburg coal. The writer collected a sample of the oil from the latter point that tested 42.1° Baume. So far as known to the writer it has not produced either oil or gas in

the Marshall-Wetzel-Tyler area, although its horizon has been recognized in some of the few wells drilled below its horizon. The log of the W. V. Hoge No. 1 well (M 126), located on the east bank of Fish creek, 1 mile north of Bannen P. O., Liberty district, Marshall county, reports 10 feet of sand coming 2460 feet below the Pittsburg coal and 372 feet below the top of the Gordon sand. This appears to correlate with the Bayard sand.

The Speechley Sand?

In western Marshall county, a showing of oil has been found in two different wells in a sand coming 2630 to 2660 feet below the Pittsburg coal. The first of these is the Boggs run deep well (M 7) in the extreme northwest portion of Marshall, where a sand 40 feet thick, is reported as coming 2631 feet below the Pittsburg coal. A slight showing of oil was found in this sand. The other well is located 15 miles southward, and was drilled by the South Penn Oil Co., on the J. F. Dobbs farm (M 81), on a branch of Maggoty run of Fish creek, 3.2 miles south of Glen Easton. What appears to be the same sand as the one in which the oil show was encountered in the Boggs run deep well, was found in the Dobbs well at a depth of 3344 feet, coming 2659 feet below the Pittsburg coal, and 673 feet below the top of the Gordon sand, also having produced oil in this well, and having a thickness of 28 feet. At 21 feet in the sand a dark oil pay was struck. The well was shot at this horizon, but did not make enough oil to pay. This sand appears to correlate with the Speechley, but may represent either the 1st or 2nd Warren, or Tiona. From the showing of oil found at tihs horizon in these two wildly separated wells, it would appear that the chances are fair for the existence of a good paying pool of oil in this sand, possibly lying to the east of the line joining these two wells.

OIL AND GAS DEVELOPMENT IN THE MARSHALL-WETZEL-TYLER AREA.

Early History.

The early history of the oil and gas development in the Marshall-Wetzel-Tyler area began with the opening up of the **Sistersville oil pool,** one of the largest and richest ever developed in West Virginia. Dr. I. C. White[13] has the following to say concerning the early history of this field:

"The **Sistersville oil pool,** one of the largest and richest ever developed in the state was opened up by the Miller's Run Oil Company, which completed a well on the Stewart farm, opposite Sistersville, on June 26th, 1891. A hole had been sunk to the **"Big Injun" sand,** on the West Virginia side of the river, more than a year before at a locality known as the "Pole cat" well, but as salt water was present in great abundance no attempt was made to exhaust the same. When it was later discovered that salt water was present with the oil in nearly all of the wells in the Sistersville pool, the old "Pole cat" well was operated and proved a large producer.

"The Sistersville field occupies the crown of a broad low arch, where the relief is not sufficiently great to permit the separation of the large quantities of gas, oil and water that are present, and hence the three remain intermingled at every point in the field, except one or two small areas (and they are where the **"Big Injun"** lies highest) where gas alone is produced.

"The production of the Sistersville pool (including the portion in Ohio) attained 20,000 barrels daily when at its height, which is probably twice the maximum production of any other pool yet found in the state."

The original Pole cat run well, or Joshua Russell No. 1 (T 9), now owned by the Carter Oil Co., is still producing oil, although drilled in during July, 1890, but it did not produce any oil in paying quantities on account of salt water until the following year. The life of this well, 18 years, has been prolonged by the presence of salt water in the sand along with the oil, both

13. Vol. I, pp. 355-356.

being pumped out of the well into the same tank and separated by the gravimetric method. The presence of the salt water along with the oil has tended to rinse out the sand and thus prevents the clogging up of its porous structure by deposits of paraffine, etc., in this way causing a much greater percentage of recovery of the total oil present in the sand, as well as lengthening the productive life of the well.

The next great field to be opened up was the **Stringtown pool** on Indian creek in eastern Tyler county in 1896. The oil in this field comes from both the Big Injun and Gordon sands and is the largest connected pool in the State, having a length of about 17 miles and a width varying from 2 to 5 miles. This pool extends from central Wetzel county southwestward entirely across eastern Tyler, and finally dies out in Doddridge county, 3½ miles northeast of West Union.

During the year 1896 a **shallow sand** oil pool was also opened up on Little Grave creek, 2 miles northeast of Moundsville in Marshall county. As mentioned on a preceding page of this report, the oil in this pool was found in the **First Cow Run sand** of the drillers, or Saltsburg sandstone of the Conemaugh series.

Other important fields opened up about this time or a few years later were the **Elk Fork, Hardman, Kyle** and **Wick** areas of Tyler county; the **Piney Fork, Smithfield, Buffalo run, Garner, Pine Grove, Jacksonburg, Burton, Steels run,** and **Folsom** and several other minor fields of Wetzel; and the **Cameron, Adaline, Bellton and Majorsville** fields of Marshall county. All these are taken up and discussed more in detail on subsequent pages of this report.

MARSHALL COUNTY WELL RECORDS.

As heretofore mentioned on preceding pages of this report, the greatest source of information concerning the character and thickness of the various formations of great economic interest where they lie deeply buried below drainage has been from the logs of the numerous wells that have been drilled all over the three counties in the search for oil and gas by private

companies and individuals. Through the courtesy of these various interests the writer has been enabled to collect the records of several hundred wells, on most of which levels were taken in the preparation of the structure contour map accompanying this report. It is true that in some instances these records are very meagre, in that frequently only the principal oil and gas horizons and possibly one or more coal beds are given, yet they give a fair idea of what is found beneath, even though it is impossible to draw from them any geologic conclusions of great value. The importance of keeping accurate and detailed records of all strata passed through from a scientific standpoint cannot be overestimated. It is especially important that the driller should note the position, thickness and character of **all coals, red beds, limestones, sandstones** and **dark slates,** as well as the exact horizon at which oil, gas or water is encountered. Dr. I. C. White[14] has the following to say concerning the importance and value of such records:

"*******The geologic data thus given to the citizens of our domain practically free of expense, has cost the operators millions of dollars to secure, in their fruitful search with the drill. That they will spend many millions more in piercing the rocky envelope of the State for these treasures of light and fuel, goes without saying. The writer has endeavored to enlist the aid of the Carnegie Institution of Washington, D. C., in an effort to secure more carefully kept records rendered available to geology through this enormous expenditure of money in drilling for oil and gas in West Virginia, but as yet the officers of that Institution have failed to embrace this opportunnity to add so immensely to the sum of human knowledge at only a small outlay in money. The great oil producing companies would most heartily co-operate in any such endeavor by giving facilities for securing samples of the drillings, making more numerous and accurate (steel line) measurements, etc., but they cannot be expected to do such purely scientific work at their own expense, and entirely on their own initiative. If the Survey could secure the funds

14. Vol. I (a) Preface, W. Va. Geol. Survey.

to employ two men at the modest salaries ($60 to $75 per month), one to attend the drill by day, and the other by night, recording measurements and securing samples from every sand pumping, the results thus obtained would prove of the greatest value, especially in the distant future of the State, when the search for oil and gas shall have long been ended with their exhaustion, and a knowledge of the State's deeply buried coal resources shall prove of great value to her citizens. It is hoped that some means of securing and preserving such valuable data now rendered possible in so many counties, may soon be obtained before the enormous expenditures required in drilling operations shall have ended forever."

The accompanying table contains the abbreviated records of nearly 100 wells in Marshall county as well as the levels above tide on several other wells of which the writer was unable to abtain a record at this time. These records have been chosen on account of their wide distribution and in some cases on account of some certain special features connected with the well. All diamond drill borings within the area known to the writer are also listed as core tests. These wells are numbered consecutively from one up, and grouped largly by magisterial districts, the serial number in each case corresponding to the number of the same well on the economic geology map accompanying this report in a separate cover. Similar tables are found on subsequent pages for Wetzel and Tyler counties, and in nearly all cases where one of these tabulated wells has been mentioned in the text, the serial number of the well along with the initial letter of the county in which it is found, has been added in parenthesis. Thus, (M 100) refers to the serial number of a tabulated well in the Marshall county list, or the J. K. Alley No. 1 well, located in Meade district, Marshall county. In like manner (W 199) and (T 204) refer to the serial numbers of wells given in the Wetzel and Tyler tables respectively.

Under the column headed "Owner" in the table of well records for Marshall county, the following abbreviations are used:

Burt Oil ..... Burt Oil Company
Carnegie ..... Carnegie Natural Gas Company.

Carter .....Carter Oil Company.
Chartiers.....Chartiers Oil Company.
Hope .....Hope Natural Gas Company.
Kanawha .....Kanawha Oil Company.
National .....National Production Company.
Octo .....Octo Oil Company.
O. & W. Va. O. .....Ohio & West Va. Oil Company
Phila. ..... Philadelphia Company
Scott O. & G. .....Scott Oil & Gas Company
South Penn .....South Penn Oil Company
Steubenville .....Steubenville Oil Company
Tri-State .....Tri-State Gas Company
Venture .....Venture Oil Company
Virginia .....Virginia Oil & Gas Company
W. Va. O. & G. .....West Va. Oil & Gas Company
Wheeling .....Wheeling Natural Gas Company
Whg. C. & C. .....Wheeling Coal & Coke Company
Whg. D. Co. .....Wheeling Development Company

In the elevation column the letter B indicates that the elevation of the top of the hole was obtained by aneroid checked on nearby U. S. G. S. spirit level elevations; the letter L by spirit level measurement. Under column headed "Elevation" figures mean, distance in feet above tide.

Summarized record of

No. on Map	NAME OF WELL	Location, District	Owner	Elev'tion
1	Nancy McCarthy No. 4..	Washington	Octo	810B
2	G W. Conners No. 8.....	Union	Octo.....	.....
3	Frank Wasmuth.....	Washington	Octo	.....
4	Ed Francis No. 1.....	Washington	South Penn	.....
5	John Otte No. 2.....	Washington	John Otte.....	785B
6	John Otte No. 3...	Union	John Otte.....	.....
7	Boggs Run Deep Well...	Union	Wheeling.....	900B
8	G P. Folmar No. 1	Sand Hill.....	Virginia..	719L
9	Maria Downing No. 1...	Union	Virginia	725B
10	Silas Davis.....	Union	Virginia	.....
11	R. E. Cook No. 1.....	Webster	....	.....
12	Lem Leach No. 1	Washington	Carter	1060B
13	L. Burley No. 1	Webster	J. H. Fable.....	1030B
14	W. L. Dague No. 1.....	Webster	J. H. Fable.	800B
15	W. W. Ewing core test..	Sand Hill.....	J. V. Thompson	795B
16	A. Caldwell core test.. ..	Sand Hill.....	J. V. Thompson	780B
18	Will Dague No. 1.....	Webster	South Penn	830B
19	I. V. Hicks core test.....	Webster	J. V. Thompson	810B
20	J Sheppard No.1	Union	W. Va. O. & G.	775B
21	Upton Dorsey No. 1.....	Webster	South Penn	1035B
22	S. Lightner No. 1.....	Webster	Wheeling.....	1015B
23	S. T Alley core test.....	Sand Hill.....	J. V. Thompson	865B
24	J. T. Cox No. 1.....	Webster	Carter	1040B
25	S. T. Alley No. 1	Sand Hill.....	Virginia.....	830B
26	S. T. Alley No. 3.....	Webster	Virginia..	830B
27	Jos. Harsh No. 1..	Sand Hill.....	Virginia.....	825B
28	Wm. Koontz No. 1.	Washington	.....	720B
29	J. B. Potts No. 1.....	Clay	....	750B
30	Silas Hammond No. 1...	Washington	.....	770L
31	Klages Hrs. No. 1.....	Sand Hill.....	Davis & Son.. ...	698L
32	G. P. Folmar core test...	Sand Hill.....	J. V. Thompson	714L
33	Jno. Armstrong No 1...	Sand Hill.....	....	1110B
34	S. T. Alley No. 2.....	Richhill.	Virginia	830B
35	C. S. Frye No. 1.....	Cameron.....	Phila.	1125B
36	E. P. Lough No. 1.....	Cameron....	Wheeling.....	1175B
37	B. F. Phillips No. 1.....	Aleppo	Wheeling.....	1175B
38	Silas Archer No. 1.....	Richhill	Carnegie	1180B
39	Mary V. Wilson No. 1...	Meade	Hope	1280B
40	Elijah Williams No. 1...	Liberty.....	Hope	1420B
41	W. H. Hicks No. 1.....	Cameron.....	Wheeling?.....	1020B?
42	Rosbys Rock Well.....	Clay	Burt Oil.....	770B
43	Gorby Hrs. No. 1	Meade	Wheeling	1395B
44	L. (J.M.) M'Cardal No.1	Meade	Hope.....	1220B

Wells in Marshall County.

PITTSBURG COAL,			BIG INJUN SAND		GORDON SAND		Total Depth	Producing Sand	No. on Map
Depth	Elevation (top)	Thickness	Depth	Thickness	Depth (top)	Thickness			
300	510	10	....	....	.....	.. ...	617	I Cow Run. .	1
585	....	.....	.....	.. ...	.....	.....	903	I Cow Run....	2
400	.....	10	.....	.. ..		.....	723	I Cow Run....	3
520	.....	5	1650	140	2524	11	2807	....	4
275	510	6	.....	.....	.. ..	.....	599	I Cow Run....	5
287	..	6	....	.....	.....	.....	605	I Cow Run....	6
324	576	6	....	.	.....	.....	4500	.....	7
230	489	6	1320	170	.....	....	1962	Gas Sand.....	8
211	514	6	.....	.....	.....	.....	904	Gas Sand.....	9
221	.. .	6		.....	.. ..	.....	970	Gas Sand.....	10
.....	. ..	....	..	..	..	.....	.....	.....	11
545	515	7	1590	250	2440	.....	2707	.....	12
548	492	7	..	.....	.....	.....	2757	... .	13
278	522	8	1406	.....	.....	.....	... .	....	14
276.6	520	7.9	..	. ...	....	.....	290.8	. .....	15
315	465	10	.	....	.....	.....	.....	....	16
296	534	. ..	1335	150	.....	.....	.....	....	18
.....	.	.....	.....	.....	... ..	.....	.....	... .	19
(275)	500	9	.....	.....	.....	... ..	... ..	..... .	20
490	545	6	1675	150	.. ...	... ..	2651	....	21
560	455	5	1665	202	.....	.... .	3023	.....	22
.....	.... .	.....	.....	...	.....	.....	.....	... .	23
575	465	5	1770	165	.....	.....	1935	....	24
274	556	6	1405	.....	.....	.....	1483	Big Injun	25
.....	...	...	.....	.....	.....	.....	.....	Big Injun	26
269	550	7	.....	.....	.....	.....	.....	.....	27
.. ..	.....	.....	.....	.....	.....	.... .	.....	.....	28
.....	.....	.....	.....	.....	.....	.....	.....	.....	29
.....	.....	....	... ..	.....	.....	.....	.....	.....	30
.....	.....	.....	.....	.....	.....	.....	.....	... .	31
178	536	4.5	.....	.....	.....	.....	.....	....	32
586	535	.....	1710	275	2545	10	3108	Fifth.....	33
278	552	7		.....	.....	.....	.....	Gas Sand....	34
.....	.....	.....	.....	.....	.....	.....	.....	.....	35
698	477	8	1820	240	2702	47	3157	Gordon	36
701	474	.... .	1820	320	.....	0	3014	"30 Foot"....	37
638	542	.....	.....	.....	.....	.....	..	.....	38
920	360	8	2015	285	2902	32	4206	... .	39
1080	340	8	....	.....	.....	.....	.....	Big Injun ...	40
.....	....	... ..	.....	... ..	.....	.....	.....	.....	41
350	420	.....	1475	195	.....	.....	2920	....	42
1040	355	5	2150	250	3043	17	3522	.....	43
.....	.....	.....	.....	....	.. ...	.....	.....	Gordon?.....	44

Summarized record of

No. on Map	NAME OF WELL	Location. District	Owner	Elev'tion
45	R. J. Gorby No. 1	Meade	Hope	1085B
46	C. Y. McCardal No. 1	Meade	Hope	950B
47	Jennie Minor No. 1	Meade	Wheeling	830B
48	Jno. W. West No. 1	Meade	Wheeling	790B
49	Isaac Crow No. 2	Meade	Wheeling	775B
50	Jos. Richmond No. 1	Meade	Hope	1265B
51	Isaac Crow No. 1	Meade	Wheeling	720B
52	John Young No. 1	Meade	Wheeling	795B
53	Reason Young No. 1	Meade	Hope	745B
54	G. B. Alley No. 1	Meade	Hope ?	790B
55	Jno. Eller No. 1	Meade	Hope	1240B
56	Jos. Shutler No. 4	Meade	Tri State	1310B
57	J. R. Kelley No. 1	Meade	Hope	1300B
58	E. Workman core test	Franklin	J. E Barnes	635B
59	John Loar No. 1	Springhill Twp		1000B
60	J. W. Mackey No. 1	Liberty	South Penn	1010B
61	Ed Dorsey No. 1	Liberty	Wheeling	1090B
62	G. W. Hicks No. 1	Cameron	Wheeling	1290B
63	John Wendt No. 1	Liberty	Wheeling	1350B
A63	Geo. Yoders No. 1	Springhill	South Penn	1050B
64	J. E. Wilson No. 1	Liberty	Wheeling	1095B
65	Gartland Hrs. No. 1	Liberty	Wheeling	1160B
66	Brice Howard Hrs. No. 1	Liberty	Wheeling	1290B
67	C. C. Lough No. 3	Liberty	South Penn	1210B
68	Thompson Hrs. No. 11	Liberty	Chartiers	1405B
69	Wm. Gray No. 5	Liberty	South Penn	1390B
70	John Bruhn No. 7	Liberty	South Penn	1390B
71	V. P. Gorby No. 1	Liberty	South Penn	1320B
72	G. Richter No. 2	Liberty	South Penn	1380B
73	Lewis Chambers No. 2	Liberty	South Penn	1355B
74	P. M. Conner No. 2	Liberty	South Penn	1360B
75	F. E. Wayt No. 1	Liberty	South Penn	1310B
76	H. E. Gray No. 1	Liberty	South Penn	1300B
77	G. W. Bowers No. 1	Meade	South Penn	755B
78	Alley-Lewis No. 4	Meade	South Penn	745B
79	Nathan Sheppard No. 1	Meade	South Penn	740B
80	Gertrude Stein No. 7	Meade	South Penn	1395B
81	J. F. Dobbs No. 1	Liberty	South Penn	980B
82	John Bruhn No. 2	Liberty	South Penn	1355B
83	Joshua Yoho No. 1	Liberty	South Penn	1080B
84	Joshua Yoho	Liberty	Carnegie	1145B
85	A. J. Fronaphel No. 2	Meade	South Penn	1325B
86	St. Jos. Church No. 1	Meade	Hope	1390B

Wells in Marshall County, (continued).

PITTSBURG COAL			BIG INJUN SAND		GORDON SAND		Total Depth	Producing Sand	No. on Map
Depth	Elevation (top)	Thick-ness	Depth	Thick-ness	Depth (top)	Thick-ness			
....	...	.....	...	.....	.....	....	.	Gordon?....	45
.....	...	....	....	....	..	..	3600	....	46
540	290	5	1637	238	2523	22	2545	Gordon	47
470	320	6	1600	235	2436	34	2470	Gordon	48
416	360	4	1541	240	2399	17	2416	Gordon	49
....	....	...	.....	....	.....	.....	...	... .	50
376	344	10	1497	278	.....	.....	2375	Gord. Stray...	51
516	279	6	1640	400	.....	...	2529	Gord. Stray...	52
.. ..	....	.. ..	.....	.....	.....	.....	.....	.....	53
.....	.....	...	.....	.....	.....	....	.....	....	54
.....	..	.....	... .	.....	.....	.....	.....	.....	55
920	390	.	2005	.....	.....	....	.....	.....	56
.. ..	....	.....	.. ..	.....	.....	.....	...	....	57
236.7	398.3	5.6	.....	.....	.....	.....	242.3	....	58
.....	.....	.. ..	.....	.....	...	...	....	... .	59
745	265	....	1920	310	2875	10	3249	Big Injun ...	60
660	430	. ..	1825	..	....	.....	.....	Big Injun?....	61
830	460	6	1990	290	.....	0	3276	30 Foot.....	62
.....	.....	.....	. ..	.....	.....	.....	.....	... .	63
833	217	8	.....	.....	.....	.....	.....	....	A63
764	330	11	.....	.....	.....	.....	.. ..	Gord. Stray...	64
780	380	.....	.....	.....	.....	....	.....	Salt	65
898	390	....	2045	252	.....	.. .	.....	Gord. Stray..	66
890	320	5	2000	260	2885	26	2913½	Gordon	67
. .	..	.....	...	...	...	...	...	Gordon	68
1102	288	4	2240	250	3097	30	3129	Gordon	69
1105	285	4	2242	253	3106	30	3142	Gordon	70
1027	293	6	2165	245	3035	21	3067	Gordon	71
1084	296	8	2202	230	3059	26	3100	Gordon	72
1040	315	5	2165	235	3022	25	3050	Gordon	73
1108	252	7	2220	240	3090	20	3112	Gordon	74
1020	290	4	2150	265	3002	21	3027	Gordon	75
1030	270	5	2148	252	3016	30	3049	Gordon	76
500	255	6	1682	238	2487	27	2515	Gordon	77
474	270	6	1606	230	2460	14	2474	Gordon	78
460	280	7	1660	145	2446	15	2463	Gordon.....	79
1128	267	5	2258	270	3152	17	3174	Gordon.....	80
685	295	5	1790	150	2671	27	3411	G.& Speechley	81
1090	265	6	2185	245	3085	15	3108	Gordon	82
860	220	5	1975	175	2852	25	2877	Gordon	83
890	255	.....	2110	....	..	.....	3218	.....	84
1040	285	5	2165	255	3031	9	3040	Gordon.....	85
1087	303	10	....	.. ..	3085	13	3123	Gordon.....	86

Summarized record of

No. on Map	NAME OF WELL	Location, District	Owner	Elev'tion
87	E. Brinkmier No. 1	Meade	Hope	1300B
88	Gertrude Stein No. 1	Meade	South Penn	1400B
89	Redfox Hrs. No. 3	Meade	South Penn	1385B
90	Jos. Nolte No. 6	Meade	South Penn	1415B
91	Jos. Nolte No. 1	Meade	South Penn	1335B
92	Fred Wayman No. 2	Meade	Wheeling	1295B
93	Jos. Klug No 5	Meade	Venture	1310B
94	Jas. Mossey No. 1 (?)	Meade	Wheeling	845B
95	Anderson core test	Meade	J. E. Barnes	770B
96	Ellen C. S. Fleming No.1	Meade	Wheeling	930B
97	W. S. Howard No. 1	Franklin	Hope	750B
98	T. J. West No. 1	Meade	Hope	745B
99	A. Richmond Hrs. No.1	Meade	Hope	735B
100	J. K. Alley No. 1	Meade	South Penn	750B
101	S. Richmond No. 1	Meade	South Penn	815B
102	John Rutan No. 1	Meade	South Penn	845B
103	John Higgins No. 4	Clay	National	
104	Widow Beall No. 2	Clay	Scott O. & G.	650B
105	Hammond core test	Franklin	Wheeling C.&C.	621L
106	Eva Sims No. 1	Franklin	Steubenville	720B
107	McFarland core test	Franklin	Wheeling C.&C.	635L
108	A. Q. Whittaker No. 1	Franklin		660B
109	C. Higgs core test	Franklin	J. E. Barnes	660B
110	Geo. Peters core test	Franklin	A. Dempster	625B
111	C. P. Wells core test	Franklin	A. Dempster	637L
112	D. Abersold core test.	Franklin	J. E. Barnes	688L
113	P. P. Campbell No. 1	Franklin	Tri State	990B
114	J. Yoho No. 1	Franklin	Tri State	1305B
115	Vincent Yoho No. 1	Franklin	Tri State	1185B
116	Vincent Yoho No. 2	Franklin	Wheeling	1320L
117	Jas. Henry No. 1	Franklin	Wheeling	1180B
118	Robt. Teagarden No. 1	Liberty	O. & W. Va. O.	800B
119	J. L. Hoffman No. 1	Liberty	Wheeling	850B
120	J. N. Crim No. 1.	Liberty	Kanawha	850B
121	Marshall Co. Bank No.1	Liberty	Wheeling	910B
122	G. Peterson No. 5	Liberty	South Penn	1425B
123	Lindsay Burley No. 4	Liberty	South Penn	1360B
124	Lindsay Burley No. 1	Liberty	South Penn	1320B
125	W. V. Hoge No. 2	Liberty	South Penn	920B
126	W. V. Hoge No. 1	Liberty	South Penn	820B
127	Donald Franklin No. 1.	Liberty	South Penn	835B
128	Mathias Brant No. 1	Liberty	South Penn	1290B

Wells in Marshall County, (continued).

PITTSBURG COAL			BIG INJUN SAND		GORDON SAND		Total Depth	Producing Sand	No. on Map
Depth	Elevation (top)	Thickness	Depth	Thickness	Depth	Thickness			
963	337	7	.....	.....	.....	.....	.....	.....	87
1130	270	10	2260	250	3141	18	3165	Gordon	88
1125	260	5	.....	.....	.....	.....	.....	Gordon	89
1168	247	.....	2285	265	3170	16	.....	Gordon	90
.....	.....	.....	.....	.....	.....	.....	.....	Gordon	91
965	330	10	2085	255	2968	18	2986	Gordon	92
.....	.....	.....	.....	.....	.....	.....	.....	Gordon	93
.....	.....	.....	.....	.....	.....	.....	.....	Gordon	94
385	385	4.5	.....	.....	.....	.....	390	.....	95
535	395	.....	1660	300	2530	18	2548	Gordon	96
353	397	6	1470	253	2352	17	2369	Gordon	97
410	335	.....	.....	.....	.....	.....	.....	Gordon	98
.....	.....	.....	.....	.....	.....	.....	.....	Gordon	99
(360)	.....	.....	.....	.....	.....	.....	.....	Gordon	100
565	250	7	1705	270	.....	.....	.....	Gordon	101
624	221	6	1790	268	2636	13	2683	.....	102
512	.....	6	1570	.....	.....	.....	1652	I Cow Run	103
136	514	7	1215	.....	.....	.....	1338	.....	104
85.7	535.3	6.5	.....	.....	.....	.....	301	.....	105
.....	.....	.....	.....	.....	.....	.....	.....	Big Injun	106
94.5	540.5	7.8	.....	.....	.....	.....	104	.....	107
.....	.....	.....	.....	.....	.....	.....	1800	.....	108
217	443	7.9	.....	.....	.....	.....	225	.....	109
.....	.....	5	.....	.....	.....	.....	.....	.....	110
258	379	5.3	.....	.....	.....	.....	265	.....	111
310.8	377	5.9	.....	.....	.....	.....	317	.....	112
568	422	4	1669	248	.....	.....	2805	.....	113
870	435	.....	1975	.....	.....	.....	.....	.....	114
.....	.....	.....	.....	.....	.....	.....	.....	.....	115
.....	.....	.....	.....	.....	.....	.....	.....	.....	116
770	410	8	1880	280	2768	18	2793	Gordon	117
560	240	.....	.....	.....	.....	.....	.....	.....	118
618	232	9	1828	226	2647	20	3005	Fifth	119
620	230	8	.....	.....	.....	.....	.....	Fourth	120
625	285	.....	1845	240	2703	18	3075	Fifth	121
1198	227	8	2390	255	3260	35	3398	Gas Sand	122
1150	210	7	2360	249	.....	.....	.....	Fourth	123
1100	220	8	2305	285	3175	10	3225	Fourth	124
705	215	5	1890	230	.....	.....	.....	Big Injun	125
638	203	8	.....	.....	.....	.....	.....	.....	126
655	180	5	1843	160	.....	.....	.....	.....	127
1100	190	8	2350	250	3199	26	3342	.....	128

The foregoing table of the records of important wells is very convenient for ready reference, but it is very important that the complete record of a number of the wells should be published, for the reason that they contain information with reference to other coals than the Pittsburg bed, as well as depths and thickness to other important oil and gas horizons than the Big Injun and Gordon sands. Then, too, by far the greater portion of these well records have never been published, and it is important that they be preserved, since their accurate location is readily determined by the serial number of the well, published both with the record and on the map accompanying this report.

These records and the discussion of the various fields will now be taken up by magisterial districts in Marshall county.

UNION AND SAND HILL DISTRICTS.

Early in 1904 a small gas field was opened by the Virginia Oil & Gas Co. near the mouth of Grandstaff run on Wheeling creek. The producing horizon there occurs 700 to 725 feet below the Pittsburg coal, and possibly correlates with the Gas sand of Marion and Monongalia counties, or the Second Cow Run sand of Washington county, Ohio, where it appears to represent the extreme top of the Pottsville series, or Homewood sandstone.

The record of two wells in this field are as follows[15]:

Maria Downing Heirs' Well, No. 1 (M 9).

	Feet.	Feet
Shale	15	
Top Lime	42	
Bottom Lime	93	
Coal (Sewickley)	123 to	124½
Pittsburg Coal	211 to	217
First Cow Run Sand (Saltzburg)	517 to	553
Sand (Dunkard)	708 to	742
Salt Sand? Second Cow Run	904	

"Gas on top and best well in this field, about 5,000,000 cubic feet and rock pressure 475 pounds."

15. Vol. I (a), p. 225, W. Va. Geol. Survey.

Silas Davis Well, No. 1, (M 10).

Three and one-half miles southeast of Elm Grove Post-office. Authority, Virginia Oil and Gas Company.

	Feet.	Feet.
Top Lime	40	
Pittsburg Coal	221	to 227
First Cow Run Sand Saltzburg)	527	to 537
Sand? **(Dunkard)**	723	
Salt Sand? Second Cow Run	924	to 970

"Struck oil about 945 feet, and shot with 60 quarts below this depth, which shut off the oil and opened up the gas."

The following account by Prof. G. P. Grimsley[16] of a comparatively dry hole, drilled in the northeast corner of Sand Hill district, is of interest in that it gives a light showing of gas in the **Fifth sand:**

"A record of the John Armstrong well near the forks of Turkey run, in the northeastern corner of Marshall county, and one mile southwest of Dallas, has been received from Mr. S. D. McCloy.

John Armstrong Well, on Turkey Run, (M 33).

	Feet.	Feet.
Casing, 13-inch	82	
Coal (Waynesburg)	270	
Coal (Sewickley)	500	
Pittsburg Coal	586	
Casing, 10-inch	960	
Gas sand (gas at 1,300 feet)	1,290	to 1,440
Salt sand, Maxton (casing 8-inch at 1,505)	1,480	to 1,680
Big lime (casing 6⅝-inch at 1,690)	1,680	to 1,710
Big Injun sand	1,710	to 1,985
Thirty-foot shells (Berea?)	2,260	to 2,375
Red rock	2,435	
Fifty-foot, all shells	2,450	to 2,490
Gordon sand, all shells	2,545	to 2,555
Fifth sand (a little gas at 2,695)	2,693	to 2,700
Slate and shells	2700	to 3108
Total depth	3,108	

"The well was plugged with three plugs at 1,765 feet.

"The Waynesburg-Pittsburg coal interval gives 316 feet as the thickness of the Monongahela Series or 34 feet greater than in the Dodds well, three miles northwest. Gas was struck

16. Ohio-BBrooke-Hancock County Report, p. 256, W. Geol. Survey.

at 1,300 feet and is still escaping from the well. This sand is 704 feet below the Pittsburg coal, which would probably correspond to the gas sand at 1,003 feet in the Richmond well at Majorsville a few miles south (record given Vol. I-a, p. 227), and would represent one of the salt sands of the Pottsville Series.

"The salt sand at 1,485 feet with the "Big Lime" (Greenbrier) below, would correspond to the Maxton. The Big Injun sand is 1,124 feet below the Pittsburg coal as compared with 1,066 feet in the Dodds well, and 1,095 feet in the McGlumphy.

"The Thirty-foot shell rock would come about the Berea horizon in its interval below the Big Injun, and above the Gordon. The base of this formation is 1,789 feet below the Pittsburg coal, and in the McGlumphy the distance is 1,750 feet, and 1,740 feet in the Dodds well."

The Virginia Oil & Gas Co. opened up quite a large gas field at Majorsville around the southwest corner of Sand Hill district, in which more or less gas has been reported from the **Salt, Maxton, Big Injun, Fifty-foot, Gordon** and **Fourth** sands of which the Salt, Fifty-foot and Gordon sands are the best horizons. The log of the S. T. Alley No. 1 well was published on page 80 in connection with the Majorsville section.

The following detailed log of the E. J. Richmond well No. 1, published by Dr. I. C. White in Vol. 1 (a), pp. 227-229, W. Va. Geol. Survey reports, gives a good idea of the thickness and character of the formations below the Big Injun sand, as well as of those above.

E. J. Richmond Well, No. 1.

On Crow creek, near Majorsville. Authority, Virginia Oil & Gas Company:

	Feet.		Feet
Gravel	20	to	20
Lime	10	to	30
Slate	5	to	35
Lime (water)	11	to	46
Back slate	20	to	66
White lime (hard)	30	to	96
Black slate	20	to	116
Lime and slate	20	to	136
Lime (hard)	23	to	159
Slate	6	to	165

	Feet.	Feet.
Coal	3 to	168
Slate	20 to	188
Slate and hard lime	30 to	218
Lime	25 to	243
Lime, hard	19 to	262
Slate	13 to	275
Lime, hard	5 to	280
Pittsburg Coal (gas)	7 to	287
Slate	13 to	300
Lime	30 to	330
Red rock	5 to	335
Slate	15 to	350
Lime (hard)	10 to	360
Red rock	10 to	370
Slate	30 to	400
Lime (hard)	10 to	410
Red rock	5 to	415
Slate	20 to	435
Lime	15 to	450
Slate	30 to	480
Red rock	5 to	485
Slate	55 to	540
Red rock	10 to	550
Slate	40 to	590
Slate and lime	20 to	610
Sandstone, white	5 to	615
Slate	5 to	620
Coal (gas) Bakerstown	3 to	623
Slate	17 to	640
Lime	5 to	645
Slate	20 to	665
Red rock	10 to	675
Lime	10 to	685
Slate	65 to	750
Lime and shells	15 to	765
Sandstone, white **(Dunkard, U. Mahoning)**	30 to	795
Slate	5 to	800
Sandstone	10 to	810
Shells	15 to	825
Sandstone (white, **Lower Mahoning)**	20 to	845
Slate	5 to	850
Sandstone	25 to	875
Slate	5 to	880
Coal, gas (Lower Freeport?)	3 to	883
Slate	7 to	890
Lime (hard)	10 to	900
Slate	10 to	910
Sandstone	10 to	920
Lime	15 to	935
Sandstone	15 to	950
Slate	10 to	960
Sandtsone	20 to	980
Slate	7 to	987
Sand, hard, some salt water (Gas Sand)	16 to	1003
Slate	17 to	1020

	Feet.	Feet.
Shells	5 to	1025
Slate	42 to	1067
Sandstone (black)	5 to	1072
Slate	78 to	1150
Sand (Maxton? of Geo. P. Folmar well)	30 to	1180
Slate	20 to	1200
Slate and shells	20 to	1220
Sandstone, black	10 to	1230
Shells	30 to	1260
Slate	10 to	1270
Sandstone, white (base of Pottsville)	25 to	1295
Slate and shells	20 to	1315
Lime and sandstone (probably true **Maxton Sand**)	40 to	1355
Slate, black	50 to	1405
Big Lime (sandy)	10 to	1415
Slate	15 to	1430
Big Injun Sand, hard and pebbly	40 to	1470
Shells	30 to	1500
Sandstone (base of Big Injun)	70 to	1570
Slate	70 to	1640
Shells and sandy	40 to	1680
Shale, black	20 to	1700
Slate	100 to	1800
Lime	15 to	1815
Slate	50 to	1865
Lime, hard	20 to	1885
Slate	15 to	1900
Lime (shelly)	25 to	1925
Lime (hard and sandy)	5 to	1930
"Berea Grit?"	4 to	1934
Slate	50 to	1984
Lime and slate	16 to	2000
Slate	40 to	2040
Red rock	10 to	2050
Shells	30 to	2080
Slate	20 to	2100
White slate	25 to	2125
Slate, black	8 to	2133
Sand, gas (plenty)	3 to	2136
Slate	6 to	2142
Slate	98 to	2240
Lime and pebbly sandstone ("Stray and	40 to	2280
White sandstone (hard)... Gordon	30 to	2310
Shells	30 to	2340
Red rock	5 to	2345
Shells and slate	95 to	2440
Fifth Sand (thin "break" at 2445′)	45 to	2485
Slate	35 to	2520
Red rock	50 to	2570
Shells black	7 to	2577
Lime and shells	10 to	2587
Bayard Sand, hard, dark	10 to	2597
Slate to bottom	6 to	2603

"The sand struck at 987 feet in this well, and holding some salt water, is apparently the gas sand of the wells three miles southeast from Elm Grove, since its top comes at 700 feet below the Pittsburg coal, but its position, 443 feet above the top of the Big Injun sand struck at 1,430 feet in this well, puts the horizon in the Allegheny formation instead of in the Salt Sand (Pottsville), whose base appears to come at 1,295 feet. If the gas horizon, 700 feet under the Pittsburg coal, is also in the Pottsville, this would make that formation 300 feet thick in this region, which appears excessive, compared with the Allegheny, whose top must have been struck at 845 feet, since that is only 160 feet below the lowest **red bed** of the record. This interpretation would give the Conemaugh formation a thickness of 558 feet, which is in close agreement with the results obtained in contiguous regions."

The Virginia Oil & Gas Co. reports a fine gas well on the Allison farm, three-fourths mile northwest of the Richmond well, according to page 230 of the same report referred to above, as follows:

J. M. Allison Well, No. 1.

Three-fourths of a mile northwest of E. J. Richmond well. Authority, Virginia Oil & Gas Company.

	Feet.	Feet.
Pittsburg Coal	290 to	297
Dunkard Sand, thin	750	
Gas Sand (gas at 1030, increasing to bottom at 1055')	1015 to	1055

"Good for six to seven million feet, and rock pressure 720 pounds."

"This reported rock pressure is very high for the depth, and may possibly be in error."

WEBSTER DISTRICT.

The Majorsville gas field laps over on the extreme northeast corner of Webster district, and the records given above for the Majorsville region show the succession in this corner of the district. Several dry holes have been drilled in the central and southern parts of the district. The three following well

records have been selected to publish on account of the details given therein. From the description they can readily be located on the map by the serial numbers of the wells:

Upton Dorsey No. 1 Well Record (M 21), Webster District.

Located on Granny run of Wolf run. Authority, South Penn Oil Co.

	Feet.		Feet
Coal, Washington	60	to	64
Coal, Waynesburg	198	to	203
Coal, Sewickley	405	to	409
Coal, Pittsburg	490	to	496
Little Dunkard sand **(I Cow Run)**	825	to	850
Big Dunkard sand	925	to	960
Salt sand?	1100	to	1530
Big Lime	1620	to	1675
Big Injun sand	1675	to	1825
Total	2651		
(Dry.)			

J. T. Cox No. 1 Well Record (M 24), Wolf Run.

One mile northwest of Beelers Station. Authority, Carter Oil Company.

	Feet.		Feet.
Loam	10	to	10
Gravel	5	to	15
Limestone, hard	25	to	40
Red rock	25	to	65
Slate	30	to	95
Limestone, hard	10	to	105
Red rock	5	to	110
Limestone, hard	10	to	120
Red rock	5	to	125
Slate	15	to	140
Coal (Washington)	2	to	142
Slate	15	to	157
Bluff sand (little water). **(Mannington)**	30	to	187
Break (little gas)	13	to	200
Slate, back	30	to	230
Slate, white	10	to	240
Limestone	10	to	250
Slate, black	40	to	290
Coal (gas), (Waynesburg)	6	to	296
Slate	14	to	310
Limestone	15	to	325
Slate	15	to	340
Limestone, hard	50	to	390
Slate	5	to	395
Limestone	10	to	405
Slate	5	to	410
Limestone	75	to	485

	Feet.	Feet.
Mapletown coal (Sewickley)	5 to	490
Slate	20 to	510
Limestone	35 to	545
Slate	5 to	550
Limestone	5 to	555
Slate	20 to	575
Pittsburg coal	5 to	580
Limestone (water)	5 to	585
Slate	5 to	590
Sand	5 to	595
Limestone, very hard	55 to	650
Limestone and slate	100 to	750
Red rock	50 to	800
Slate	25 to	825
Limestone	10 to	835
Slate	10 to	845
"Big Red"	100 to	945
Cow Run sand, (First)	15 to	960
Slate	10 to	970
Red rock	20 to	990
Limestone	5 to	995
Slate	105 to	1100
Dunkard sand (Mahoning)	20 to	1120
Slate	20 to	1140
Sand	20 to	1160
Break	35 to	1195
Coal, Lower Freeport)	5 to	1200
Slate	10 to	1210
Gas sand	70 to	1280
Slate	70 to	1350
Sand	10 to	1360
Slate	60 to	1420
"Salt Sand"	20 to	1440
Slate	50 to	1490.
Second **"Salt Sand,"** white (water at 1535)	85 to	1575
Black sand and slate	110 to	1685
"Big Lime"	75 to	1760
"Break"	10 to	1770
"Big Injun" sand to bottom of hole	165 to	1935

S. Lightner No. 1 Well Record (M 22), Webster District.

Located on Middle Grave creek, two miles west of Beelers Station. Authority, Wheeling Natural Gas Co.

	Feet.	Feet.
Coal (Washington)	160 to	163
Coal Waynesburg "A"	250 to	253
Coal (Waynesburg)	290 to	292
Coal Uniontown	348 to	350
Coal (Sewickley)	486 to	489
Pittsburg Coal	560 to	565
Red rock	700 to	720
Red rock	780 to	820
Little Dunkard **(I Cow Run)**	860 to	880

	Feet.		Feet.
Salt Sand (water at 1322)	1312	to	1352
Salt Sand	1352	to	1422
Big Lime	1625	to	1665
Big Injun Sand	1665	to	1867
Slate and shells	1867	to	2270
Berea Grit	2270	to	2280
Red rock	2375	to	2455
Lime and Sand	2545	to	2555
Total	3023		

WASHINGTON DISTRICT.

The First Cow Run sand oil pool on Little Grave creek is located on the northern edge of Washington district, and laps over into Union on the north. This pool has been described on a preceding page in connection with the description of the First Cow Run sand. The position of this sand, as well as thickness and depth of the several coals, is well shown by the following record:

John Otte No. 2 Well Record (M 5), Washington District.

Located two and one-half miles northeast of Moundsville. Authority, John Otte.

	Thickness Ft.	Total Ft.
Coal	1	1
Sandstone, shaly	6	7
Limestone, hard	15	22
Coal, Waynesburg	4	26
Limestone, hard, broken	70	96
Shale, bluish, cave	5	101
Limestone, softer, broken	95	196
Coal, Sewickley	4	200
Limestone, hard	70	270
Limestone, softer	15	285
Coal, Pittsburg	6	291
Limestone, hard	10	301
Shale, dark	10	311
Shale, red, cave with streaks of white	125	436
Shales, red and white, iron nodules	123	559
Coal, some places dark shale	5	564
Limestone, white, hard	20	584
Sandstone, First Cow Run	25	609
Pay 7 to 9 ft. from top.		

The record of another well near Moundsville published by Dr. I. C. White in Vol. I, pages 262-263 of the State Survey

Reports, showing the position of the **First Cow Run** sand with respect to the different coal beds, is as follows:

Gallagher Well No. 1, Near Moundsville.

Authority, Dr. J. D. States.

	Feet.		Feet.
Conductor	40	to	40
Limestone, hard	40	to	80
Coal, Sewickley	4	to	84
Limestone	72	to	156
Coal, Pittsburg	6	to	162
Slate	72	to	234
Limestone	23	to	257
Slate (10-inch casing, 264 ft.)	92	to	349
Red rock	10	to	359
Slate and red rock	85	to	444
First Cow Run sand	20	to	464
Red rock	70	to	534
Sand	60	to	594
Slate, black	5	to	599
Coal	5	to	604
Shale, blue	175	to	779
Black slate and shells	163	to	942
"Salt sand" Pottsville (sand 10; coal 3; sand 10; black slate and shells 31; sand, salt water 67)	121	to	1063
Slate and shells	82	to	1145
Big lime (Mountain), hard	85	to	1230
Slate	25	to	1255
Big Injun Sand	165	to	1420
Slate to bottom	50	to	1470

"The producing sand in the "shallow" pool[17] is the one at 444 feet in this record whose base comes 302 feet below the **Pittsburg coal**. The drillers call it the **First Cow Run sand**, and such it really seems to be, since the 70 feet of **red rock** under it puts it about the middle of the **Barrens**, and proves that it is not a member of the **Mahoning sandstone**, or **Dunkard sand series**. It is possible that this oil sand at 444 feet, 282 feet under the **Pittsburg coal**, may represent the **Morgantown sandstone**, but the top of that stratum is seldom more than 200 feet under the **Pittsburg bed**."

The record of the two following dry holes in the northwest corner of Washington district is as follows:

17. Referring to First Cow Run pool on Little Grave Creek.

Ed. Francis No. 1 Well Record (M 4), Washington District.

On Wilson run of Little Grave creek. Authority, South Penn Oil Co.

	Feet.		Feet.
Coal, Washington	115	to	118
Coal, Sewickley	440	to	444
Coal, Pittsburg	520	to	525
Big Dunkard sand	975	to	1075
Big Lime	1550	to	1650
Big Injun sand	1650	to	1790
Gordon sand	2524	to	2535
Total			2807

Lem Leach No. 1 Well Record (M 12), Washington District.

On Toms run, three-fourths mile west of Limestone P. O. Authority, Carter Oil Co.

	Feet.		Feet.
Pittsburg coal (good)	545	to	552
Cave (Big Reds)	635	to	810
Cow run sand (Saltzburg)	810	to	830
Dunkard sand	920	to	950
Salt sand?	1000	to	1300
Maxton sand (hard)	1440	to	1510
Big Lime	1510	to	1590
Big Injun sand (water, 1645′)	1590	to	1840
Gantz sand (hard)	2145	to	2160
Gordon sand, shells, hard	2440		
Fifth sand, shells and hard	2590		
Total depth (dry)	2707		

In the vicinity of Moundsville a light showing of gas was found in two or three wells on Parr run. Other dry holes are shown on the economic geology map.

CAMERON DISTRICT.

The Washington anticline crosses the southeast corner of Cameron district, Marshall, along which is found the great Cameron gas field. The two following well records are taken from wells in this portion of the district:

E. P. Lough No. 1 Well Record (M 36), Cameron District.

Located two and four-tenths miles N. E. of Cameron. Authority, Wheeling Natural Gas Co.

	Feet.	Feet.
Pittsburg Coal	698 to	706
Dunkard Sand	1120 to	1160
Gas Sand	1360 to	1460
Salt Sand	1485 to	1710
Lime	1775 to	1820
Big Injun	1820 to	2060
50 Ft. sand	2640 to	2680
Stray sand	2685 to	2697
Gordon sand	2702 to	2749

(No Sands below Gordon).

G. W. Hicks No. 1 Well Record (M 62), Cameron District.

Located three-fourths mile south of above well. Authority, Wheeling Natural Gas Co.

	Feet.	Feet.
Pitsburg coal	830	
Big Injun sand	1990 to	2280
Nineveh (Gordon Stray) sand (gas)	2845 to	2880
Total	3276	

(No Gordon, 4th or 5th).

The record of the B. F. Phillips well (M 37), located one mile northeast of the G. W. Hicks No. 1 (M 62), in the extreme northwest corner of Aleppo township, Greene county, Pa., shows the thickness of the Monongahela series here to be about 280 feet. It is as follows:

B. F. Phillips No. 1 Well Record (M 37).

Authority, Wheeling Natural Gas Co.

	Feet.	Feet.
Waynesburg coal	430	
Mapletown coal	600	
Pittsburg coal	701	
Gas sand, (II Cow Run)	1500	
Salt sand	1580	to 1745
Big Injun sand	1820	to 2140
Fifty-foot sand	2635	to 2680
Thirty-foot sand, **(gas at 2719)**	2705	to 2734
Stray sand (Dry)	2740	to 2755
Total	3014	

(No Gordon, 4th or 5th, all slate or shells.)

LIBERTY DISTRICT.

Liberty district occupies the southeast corner of Marshall county and it is crossed in a northeast-southwest di-

rection by the **Washington anticline** and the **Loudenville (Finney) syncline.** The structure is ideal for the accumulation of oil and gas, and hence this district, along with Meade, has produced more of each than all the other districts of this county combined.

Between Cameron and Woodruff there occurs a fine gas field around the **nose** of the Washington anticline. The records of the three following wells are of interest, and show the gas horizons to be the **Salt, Big Injun,** and **Gordon Stray** sands:

Ed. Dorsey, No. 1 Well, Record (M 61), Liberty District.

Located one mile due east of Cameron. Authority, Wheeling Natural Gas Co.

	Top Feet.
Coal, Waynesburg at	400
Coal, Sewickley	580
Coal and black slate, Pittsburg	660
Big Injun sand	1825
Gas sand, Stray ?	2665

B. Howard Heirs' No. 1 Well Record (M 66), Liberty Dist.

Located three-fourths mile south of Cameron. Authority, Wheeling Natural Gas Company.

	Feet.	Feet.
Coal, Waynesburg	609	
Mapletown coal **(Sewickley)**	795	
Pittsburg coal	898	
Sand, Murphy	1059	
Red rock	1260	
Little Dunkard sand	1376	to 1418
Coal, Lower Freeport	1466	
Big Dunkard sand, (Lower Freeport)	1505	to 1572
Salt sand	1625	to 1665
Sand	1680	to 1787
Sand, **Maxton**	1845	to 1910
Lime, Big	1988	to 2045
Big Injun sand	2045	to 2297
Red rock	2730	to 2785
Fifty-foot sand	2822	to 2862
Sand, Gordon Stray, gas	2915	to 2935

Gartland Heirs (Otis) No. 1 Well Record (M 65), Liberty

Located on head of Big Run, one and one-third miles southeast of Cameron railroad station. Authority, Wheeling Natural Gas Company.

	Feet.	Feet.
Coal, Washington, gas in	370	
Bluff sand	450	
Mapletown coal (Sewickley)	670	
Pittsburg coal	780	
Some gas and water in coal	784	
Red rock	1055	
First Cow Run sand	1185	to 1220
10inch casing		1240
Red rock	1265	to 1285
Coal, Lower Freeport	1350	to 1360
Gas sand	1405	to 1465
Salt sand, gas 1560	1550	
Salt sand	1740	to 1850
Big Lime	1890	to 1950
Big Injun	1950	to 2200
Gordon stray	2790	to 3030
Unrecorded to bottom	3035	to 3259

(Salt sand, gas; Dry in Stray and Gordon.)

In the southeast corner of Liberty district there occurs a small oil pool in what appears to be the Fourth sand. The records of the seven following wells will show not only the sands encountered by the driller, but the coal beds as well:

J. L. Hoffman No. 1 Well Record (M 119), Liberty District.

Located one mile west of Bellton (Denver Station). Authority, Wheeling Natural Gas Company.

	Feet.	Feet.
Bluff sand	300	to 305
Waynesburg coal	305	to 308
Mapletown coal (Sewickley)	500	to 504
Pittsburg coal	618	to 624
Murphy sand (hole full of water at 828′)	822	to 857
Little Dunkard sand	1080	to 1096
Big Dunkard sand	1104	to 1204
Sand, (II Cow Run) (little gas at 1345′)	1338	to 1356
Gas sand, (II Cow Run)	1366	to 1413
Salt sand	1494	to 1552
Salt sand	1615	to 1650
Maxton sand (Little gas at 1708′).	1678	to 1732
Big Lime	1754	to 1818
Pencil cave	1818	to 1828
Big Injun	1828	to 2054
Fifty-foot sand	2585	to 2600

	Feet.	Feet.
Gordon Stray	2617	to 2622
Gordon sand (good)	2647	to 2667
Shell	2690	to 2692
Fourth sand	2713	to 2725
Fifth sand (gas)	2745	to 2748
Unrecorded	2748	to 3005

Marshall County Bank (H. S. White) No. 1 (M 121).

Located on Harts Run, one-half mile north of Bellton (Denver Station). Authority, Wheeling Natural Gas Co.

	Feet	Feet
Coal	535	
Pittsburg coal	625	
Gas	650	
Salt sand	1510	
Maxton sand	1730	
Big lime	1790	
Big Injun sand	1845	to 2085
Thirty-foot shells	2440	
Red rock	2540	
Stray, Gordon, sand	2640	to 2665
Sand, Gordon	2703	to 2721
Sand, Fourth (some gas)	2734	to 2746
Sand, Fifth (oil; about 5 bbl. well)	2770	to 2778
Unrecorded to bottom	2778	to 3075

G. Peterson No. 5 Well Record (M 122), Liberty District.

Located three-fourths mile southwest of Bellton. Authority, South Penn Oil Company.

	Feet.	Feet.
Coal, Pittsburg	1198	to 1206
Big Dunkard sand	1727	to 1785
Salt sand	2113	to 2238
Gas at 1945.		
Big Injun sand	2390	to 2648
Fifty-foot sand	3180	to 3190
Gordon Stray sand	3210	to 3230
Gordon sand	3260	to 3295
Fourth sand	3303	to 3312
Fifth sand	3332	to 3335
Unrecorded to bottom	3335	to 3398
Abandoned as dry.		

The gas at 1945 appears to be in the Second Cow Run sand.

Lindsay Burley No. 1 Well Record (M 124), Liberty District.

One-half mile west of Bellton. Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg coal (steel line meas.)	1100	to	1108
Dunkard sand	1580	to	1640
Salt sand	2000	to	2050
Maxton sand	2230	to	2240
Big lime	2250	to	2305
Big Injun sand	2305	to	2590
Berea sand	2800	to	2820
"Thirty-foot" sand	3000	to	3030
Gordon sand (gas)	3175	to	3185
Fourth sand (oil 3210)	3208	to	3216
Unrecorded to bottom	3216	to	3225

The Berea sand, coming 1700 feet below the Pittsburg coal, appears to be represented in this well.

W. V. Hoge No. 2 Well Record (M 125), Liberty District.

Located two miles south of Bellton (Denver Station). Authority, South Penn Oil Company.

	Feet.		Feet.
Pittsburg coal (steel line)	705	to	710
Dunkard sand	1200	to	1250
Salt sand	1700	to	1730
Maxton sand	1831	to	1850
Big lime	1860	to	1890
Big Injun sand	1890	to	2120
Gas and oil 1985'.			
"Thirty-foot" sand	2765	to	2785
Gordon sand	2796	to	2804
Fourth sand	2827	to	2833
Fifth sand	2858	to	2861
Unrecorded to bottom	2861	to	2889

This well produced one tank of oil from the Big Injun sand and was finally abandoned.

W. V. Hoge No. 1 Well Record (M 126), Liberty District.

Located on W. Va. Fork of Fish creek, one-half mile west of No. 2. Authority, South Penn Oil Company.

	Feet.		Feet.
Mapletown coal (**Sewickley**)	520	to	525
Pittsburg coal (steel line)	620	to	628
Big Injun sand	1805	to	2090
Gordon Stray sand (oil show at 2682')	2682	to	2694
Gordon sand (oil show at 2708')	2708	to	2723
Fourth sand	2752	to	2760
Bayard sand	3080	to	3090
Unrecorded to bottom	3090	to	3113

The Bayard sand appears to be represented in this well, coming 2460 feet below the top of the Pittsburg coal and 372 feet below the top of the Gordon sand. There seems to be a good thickness of both Sewickley (Mapletown)and Pittsburg coals.

Mathias Brant No. 1 Well Record (M 128), Liberty District.

One-half mile south of Boardtree Station. Authority, South Penn Oil Company.

	Feet.	Feet.
Coal, Pittsburg	1100	to 1108
Dunkard sand	1600	to 1630
Gas sand, (II Cow Run)	1858	to 1920
Salt sand	2000	to 2125
Big lime	2254	to 2342
Big Injun sand	2350	to 2600
Break of slate	2431	to 2450
"Fifty-foot" sand	3050	to 3080
Gordon Stray sand	3135	to 3143
Slate	3143	to 3199
Gordon sand	3199	to 3225
Fifth sand (Fourth)	3238	to 3245

Light gas at 3242'.

The Carnegie Natural Gas Company drilled a dry hole in the extreme southwest corner of Liberty district. Its record is as follows:

Joshua Yoho No. 1 Well Record (M 84), Liberty District.

Located near Howard P. O., 3.3 miles west of Bannen. Authority, Carnegie Natural Gas Company.

	Top. Feet.	Bottom. Feet.
Pittsburg coal	890	
Big Injun sand	2110	
No Fifty-foot sand.		
Gordon Stray sand, close and hard	2910	
Unrecorded	2910	3218

The northeast extension of the old Garner pool of Wetzel county, passes almost entirely across the northwest corner of Liberty district, and nearly 100 Gordon sand oil wells are found within the boundary, scattered along the eastern flank of the New Martinsville anticline. Although the Garner pool was opened in 1899 its extension northeastward

into Liberty district did not take place until 1901 or 1902. The relation of this pool to geologic structure is in complete agreement with the **anticlinal theory**[18] of Dr. I. C. White. The following well records, 11 in number, scattered from Cameron southwest along the pool to the Liberty-Meade district line at Fish Creek, give valuable data with reference to oil and gas horizons as well as the several **coal beds.** The measurements in all these wells to the Pittsburg coal and Gordon sand were made with a **steel line** and should give the interval between these two formations very accurately:

C. C. Lough No. 3 Well Record (M 67), Liberty District.

¾ mile due west of Cameron Station. Authority, South Penn Oil Co.

	Feet.		Feet.
Coal, Waynesburg "A"	540	to	545
Coal, Mapletown **(Sewickley)**	795	to	800
Coal, Pittsburg (Steel line)	890	to	895
Salt sand	1625	to	1825
Big lime	1960	to	2000
Big Injun sand	2000	to	2260
Gordon stray sand	2840	to	2845
Gordon sand (steel line)	2885	to	2911
First pay of oil	2885	to	2898
Unrecorded to bottom	2911	to	2913½

The top of the Big Injun sand comes only 1110 feet below the top of the Pittsburg coal, and top of the Gordon sand comes 1995 feet below the top of the same bed. The coal occurring at a depth of 540 feet is evidently the **Waynesburg "A"** bed, since the Waynesburg proper should come about 300 feet above the Pittsburg bed.

Wm. Gray No. 5 Well Record (M 69), Liberty District.

Located 2 miles southwest of Cameron Station. Authority, South Penn Oil Co.

	Feet.		Feet.
Coal, Waynesburg	800	to	803
Mapletown coal **(Sewickley)**	1010	to	1014
Pittsburg coal (steel line)	1102	to	1106
Salt sand	1725	to	2030
Big lime	2200	to	2240
Big Injun sand	2240	to	2490

18. Vol. I (a) pp. 49-52, W. Va. Geol. Survey.

	Feet	Feet.
Gordon Stray sand	3045	to 3050
Gordon sand (steel line)	3097	to 3127
First oil pay	3102	to 3107
Unrecorded to bottom	3127	to 3129

John Bruhn No. 7 Well Record (M 70), Liberty District.

Located 3 miles southwest of Cameron Station. Authority. South Penn Oil Co.

	Feet.	Feet.
Coal, Washington	648	to 651
Coal, Mapletown (Sewickley)	1020	to 1023
Coal, Pittsburg (steel line)	1105	to 1109
Little Dunkard ? sand (I Cow Run)	1455	to 1480
Big Dunkard sand	1604	to 1635
Salt sand	1670	to 2045
Maxton sand	2100	to 2125
Big lime	2190	to 2242
Big Injun sand	2242	to 2495
Gordon Stray sand	3065	to 3072
Gordon sand	3106	to 3136
Oil pay		3108
Unrecorded to bottom	3136	to 3142

V. P. Gorby No. 1 Well Record (M 71), Liberty District

Located ½ mile north of Bruhn No. 7 or (M 70). Authority, South Penn Oil Co.

	Feet.	Feet.
Coal, Waynesburg "A"	688	to 692
Coal, Mapletown (**Sewickley**)	930	to 934
Coal, Pittsburg (steel line)	1027	to 1033
Little Dunkard sand (I Cow Run)	1380	to 1410
Big Dunkard sand	1520	to 1600
Salt sand	1910	to 2050
Maxton sand	2115	to 2150
Big lime	2150	to 2165
Big Injun sand	2165	to 2410
Gordon sand (steel line)	3035	to 3056
First oil pay 3037'.		
Second oil pay 3052'.		
Unrecorded to bottom	3056	to 3067
First production, 30 bbls. per day.		

In this well the **Big lime** is reported only 15 feet thick, with the **Maxton sand** lying in immediate contact with the same. The Pittsburg coal-Big Injun sand interval is 1138 feet, and the same for the Gordon sand is 2008 feet.

G. Richter No. 2 Well Record (M 72), Liberty District.

Three miles due south of Glen Easton. Authority. South Penn Oil Co.

	Feet.	Feet.
Coal, Waynesburg "A"	745	to 748
Coal, Mapletown (Sewickley)	980	to 984
Coal, Pittsburg	1084	to 1092
Salt sand	1995	to 2145
Big lime	2160	to 2202
Big Injun sand	2202	to 2432
Gordon Stray sand	3030	to 3036
Gordon sand (steel line)	3059	to 3085
First oil pay	3061	to 3063
Unrecorded to bottom	3085	to 3100

Lewis Chambers No. 2 Well Record (M 73), Liberty District.

Located ½ mile north of G. Richter No. 2. Authority, South Penn Oil Co.

	Feet.	Feet.
Coal, Waynesburg	765	to 768
Coal, Mapletown (Sewickley)	950	to 935
Coal, Pittsburg (steel line)	1040	to 1045
Salt sand	1800	to 1950
Big lime	2120	to 2165
Big Injun sand	2165	to 2400
Gordon Stray sand	2980	to 2985
Gordon sand (steel line)	3022	to 3047
First oil pay	3033	to 3037
Unrecorded to bottom	3047	to 3050

In this well the thickness of the Monongahela series is 280 feet, and it is quite evident that the coal coming about 335 to 350 feet above the Pittsburg bed in other wells in this region is the **Waynesburg "A"** bed.

P. M. Conner No. 2 Well Record (M 74), Liberty District.

Located 1¾ miles S. 10° E. of Glen Easton. Authority, South Penn Oil Co.

	Feet.	Feet.
Coal, Mapletown, **(Sewickley)**	1005	to 1008
Coal, Pittsburg (steel line)	1108	to 1115
Little Dunkard sand (I Cow Run)	1420	to 1465
Big Dunkard sand	1600	to 1681
Gas sand (II Cow Run)	1800	to 1863
Salt sand (water 2010′)	1980	to 2028
Big lime	2170	to 2220
Big Injun sand (water 2320′)	2220	to 2480
Gordon sand (steel line)	3090	to 3110
Oil pay		3092
Unrecorded to bottom	3110	to 3112

Light oil well now abandoned.

F. E. Wyat No. 1 Well Record (M 75), Liberty District.

Located 3 miles due south of Glen Easton. Authority, South Penn Oil Co.

	Feet.		Feet.
Coal, native, Waynesburg "A"	670	to	672
Coal, Mapletown (Sewickley)	920	to	923
Coal, Pittsburg (steel line)	1020	to	1024
Salt sand	1620	to	1940
Big lime	2110	to	2150
Big Injun sand	2150	to	2415
Gordon Stray sand	2960	to	2965
Gordon sand (steel line)	3002	to	3023
First pay	3014	to	3020
Unrecorded to bottom	3023	to	3027

Good oil well. Strong gas.

H. E. Gray No. 1 Well Record (M 76), Liberty District.

Located ¾ mile due north of mouth of Maggoty run. Authority, South Penn Oil Co.

	Feet.		Feet.
Coal, Waynesburg	735	to	740
Coal, Mapletown (Sewickley)	930	to	934
Coal, Pittsburg (steel line)	1030	to	1035
Little Dunkard sand	1445	to	1460
Big Dunkard sand	1510	to	1550
Salt sand	1625	to	1965
Maxton sand	2065	to	2095
Big lime	2115	to	2148
Big Injun sand	2148	to	2400
Gordon Stray sand	2995	to	3003
Gordon sand (steel line)	3016	to	3046
Unrecorded to bottom	3046	to	3049

From top of Pittsburg coal to top of Big Injun sand is 1118 feet; from top of Pittsburg coal to top of Gordon sand is 1986 feet.

J. F. Dobbs No. 1 Well Record (M 81), Liberty District.

On branch of Maggoty run, 2 miles north of Adaline P. O. Authority, South Penn Oil Co.

	Feet.		Feet.
Coal, Waynesburg	400	to	410
Coal, Mapletown (Sewickley)	580	to	585
Coal, Pittsburg	685	to	690
Little Dunkard sand (I Cow Run)	1000	to	1060
Big Dunkard sand	1210	to	1270
Salt sand	1480	to	1660
Maxton sand	1710	to	1740
Big lime	1760	to	1790
Big Injun sand	1790	to	1940

	Feet		Feet
Gordon sand	2671	to	2698
First oil pay 2673'.			
Sand, Fourth	2740	to	2743
Sand, Fifth	2803	to	2811
Sand	2898	to	2923
Sand	3191	to	3194
Sand, Speechley ? I or II Warren? or Tiona	3344	to	3372
Dark oil at 3365'.			
Sand, Tiona?	3398	to	3399
Unrecorded to bottom	3399	to	3411

This well was shot but did not make a paying well from the sand at 3344-3372 so it was abandoned. This well produced oil from the Gordon sand for a while, and then was finally drilled deeper. The sand, coming at a depth of 3344, or 2659 feet below the top of the Pittsburg coal appears to correlate with the bed in which the oil showing occurred in the Boggs run deep well (M 7) in the northwestern part of Marshall county, 15 miles northward, where it comes 2631 feet below the top of the Pittsburg coal. It may possibly correlate with the **Speechley, I Warren, II Warren** or **Tiona** sand of northern Pennsylvania.

John Bruhn No. 2 Well Record (M 82), Liberty District.

Located 2 Miles N. 20-25° E. of Adaline. Authority, Soueh Penn Oil Co.

	Feet.		Feet.
Coal, Waynesburg "A"	740	to	745
Coal, Mapletown (Sewickley)	1000	to	1002
Coal, Pittsburg	1090	to	1096
Little Dunkard sand (**I cow Run**)	1406	to	1436
Big Dunkard sand	1606	to	1626
Salt sand	2005	to	2040
Big lime	2150	to	2185
Big Injun sand	2185	to	2430
Stray sand	3050	to	3060
Gordon sand	3085	to	3100
Unrecorded to bottom	3100	to	3108

Small oil well in Gordon.

In this pool in Liberty district the Gordon sand averages about 25 feet thick. It generally has a very hard shell at the top and bottom. The best results in recovering the oil appear to be attained when the bottom shell is not entirely penetrated by the drill.

MEADE DISTRICT.

Like Liberty district, the geologic structure of Meade is very favorable for the segregation of oil and gas into paying pools. The same Gordon sand oil belt continues on its southwest course, passing through the southern part of the district via St. Joseph P. O., and crossing the Marshall-Wetzel county line in the extreme southwest corner of the district. The records of the following wells, 6 in number, scattered along this belt of oil from where the pool enters the district from Liberty to the Wetzel county line, will show the position of the various oil and gas horizons as well as thickness and depth to the several coal beds.

Geo. W. Bowers No. 1 Well Record (M 77), Meade District.

Located at mouth of Valley run of Fish creek. Authority, South Penn Oil Co.

	Feet.		Feet.
Coal, Waynesburg	204	to	209
Coal, Mapletown (Sewickley)	412	to	414
Coal, Pittsburg	500	to	506
Big Injun sand	1682	to	1920
Gordon sand	2487	to	2514
Unrecorded to bottom	2514	to	2515

John Rutan No. 1 Well Record (M 102), Meade District.

On Lynn Camp run, 2½ miles southwest of Adaline P. O. Authority, South Penn Oil Co.

	Feet.		Feet.
Coal, Washington "A"	145	to	147
Coal, Mapletown (Sewickley)	535	to	538
Coal Pittsburg	624	to	630
Salt sand	1350	to	1390
Big Lime	1750	to	1790
Big Injun sand	1790	to	2058
Stray sand	2593		
Gordon sand	2636	to	2649
Unrecorded to bottom	2649	to	2683

Light showing of oil in Gordon sand, but is located too close eastern edge of pool to make good well.

Fred Wayman No. 2 Well Record (M 92), Meade District.

Located 1 mile northwest of John Rutan No. 1 (M 102). Authority, Wheeling Natural Gas Co.

	Feet.		Feet.
Slate and limestone	12	to	80
Slate and limestone	80	to	874
Mapletown coal (Sewickley)	874	to	879
Slate and limestone	879	to	965
Pitsburg coal	965	to	975
Slate and shale	975	to	1260
Slate and shale	1260	to	1490
Litle Dunkard sand **(I Cow Run)**	1490	to	1500
Big Dunkard sand	1500	to	1590
Slate and shale	1590	to	1890
Salt sand	1890	to	2045
Big lime	2045	to	2085
Big Injun sand (gas at 2175′)	2085	to	2340
Sand and slate	2340	to	2670
Sand	2670	to	2710
Slate, shale, and **red rock**	2710	to	2960
Gordon sand (gas)	2968	to	2986

This well is located just off the west edge of the oil belt, or in other words is too high up the flank of the New Martinsville anticline to get oil, hence gas resulted in both the Big Injun and Gordon sands.

Jos. Nolte No. 6 Well Record (M 90), Meade District.

Located 8-10 mile northeast of St. Joseph P. O. Authority, South Penn Oil Co.

	Feet.		Feet.
Coal, Mapletown (Sewickley)	1075		
Coal, Pittsburg	1168		
Big Dunkard sand	1660	to	1760
Salt sand	2000	to	2200
Little lime	2205	to	2215
Pencil cave	2215	to	2225
Big lime	2225	to	2285
Big Injun sand	2285	to	2550
"Soft" sand	2900	to	2940
"Stray" sand	3120	to	3133
Gordon sand (oil at 3175′)	3170	to	3186

Gertrude Stein No. 1 Well Record (M 88), Meade District.

At St. Joseph P. O. Authority South Penn Oil Co.

	Feet.		Feet.
Coal, Washington	710	to	715
Coal, Mapletown (Sewickley)	1040	to	1045
Coal, Pittsburg	1130	to	1140
Salt sand	1810	to	2000
Big lime	2220	to	2260
Big Injun sand	2260	to	2510
"Stray"	3100	to	3105
Gordon sand	3141	to	3159
First oil pay at 3141′			
Second oil pay at 3153′			
Unrecorded to bottom	3159	to	3165

A. J. Fronaphel No. 2 Well Record (M 85), Meade District.

One-half mile southwest of St. Joseph. Authority, South Penn Oil Co.

	Feet.		Feet.
Coal Washington	600	to	605
Coal, Mapletown (Sewickley)	940	to	945
Coal, Pittsburg (steel line)	1040	to	1045
Big lime	2095	to	2165
Big Injun sand	2165	to	2420
Gordon sand	3031	to	3040

Oil pay at 3034'.

A glance at the economic geology map accompanying this report shows the northeast end of the New Martinsville anticline to be on Upper Bowman Run, 2 miles northeast of its mouth. From this point southwestward there occurs a great gas field along this arch in the rocks. The gas is found mostly in Gordon sand. The records of the following wells, 6 in number, scattered throughout the field to the Meade-Franklin district line, give important data with reference to the oil and gas horizons as well as the coal beds:

Jennie Minor No. 1 Well Record (M 47), Meade District.

Located on Upper Bowman Run, 1 mile above its mouth. Authority, Wheeling Natural Gas Co.

	Feet.		Feet.
Washington coal	65	to	67
Waynesburg coal	210	to	213
Uniontown coal	320	to	322
Mapletown coal (Sewickley)	458	to	463
Pittsburg coal	540	to	545
Little Dunkard **(1 Cow Run sand)**	865	to	875
Big Dunkard sand (Mahoning)	1025	to	1055
Salt sand (water)	1443	to	1458
Salt sand (water)	1492	to	1517
Big lime	1612	to	1637
Big Injun sand (water 90 ft. in)	1637	to	1905
Red rock	2353	to	2433
Gordon sand (gas)	2523	to	2545

John W. West No. 1 Well Record (M 48), Meade District.

Located on Upper Bowman Run, 1-3 mile south of Minor No. 1 (M 47). Authority, Wheeling Natural Gas Co.

	Feet.		Feet.
Coal, Washington	60	to	62
Coal, Waynesburg	175	to	177
Mapletown coal	380	to	385

	Feet		Feet
Pittsburg coal	470	to	476
Little Dunkard sand (**I Cow Run**)	795	to	835
Big Dunkard sand	989	to	1009
Gas sand, (Lower Freeport)	1057	to	1107
Salt sand	1274	to	1314
Salt sand	1369	to	1399
Maxton sand	1495	to	1505
Big Injun sand	1600	to	1835
Red rock	2279	to	2359
Gordon sand (gas)	2436	to	2470

Interval from top of Pittsburg coal to Big Injun sand 1130 feet.
Interval from top of Pittsburg coal to Gordon sand 1966 feet.

Isaac Crow No. 1 Well Record (M 51), Meade District.

Located on the east bank of Fish Creek, 1-3 mile above the mouth of Upper Bowman Run. Authority, Wheeling Natural Gas Co.

	Feet.		Feet.
Clay	0	to	5
Gravel	5	to	80
Gravel, sand, and lime	80	to	180
Sand, lime, and slate	180	to	280
Mapletown coal (Sewickley)	280	to	285
Slate and lime	285	to	376
Pittsburg coal	376	to	386
Lime and slate	386	to	800
Little Dunkard sand	800	to	840
Slate and shale	840	to	890
Dunkard sand	890	to	920
Slate and lime	920	to	990
Gas sand, (Lower Freeport)	990	to	1030
Slate, red rock, and shale	1030	to	1263
Salt sand	1263	to	1310
Slate	1310	to	1350
Maxton sand	1350	to	1414
Big lime	1414	to	1497
Big Injun sand	1497	to	1775
Slate and shale	1775	to	2085
Berea Grit sand	2085	to	2100
Slate and shale	2100	to	2197
Red rock, slate, and shale	2197	to	2357
Gordon sand, gas	2357	to	2375

Interval from top of **Pittsburg coal** to **Big Injun sand** 1121 feet.
Interval from top of **Pittsburg coal** to **Berea Grit sand** 1709 feet.
Interval from top of **Pittsburg coal** to **red rock** 1821 feet.
Interval from top of **Pittsburg coal** to **Gordon sand** 1981 feet.

John Young No. 1 Well Record (M 52), Meade District.

Located 1-3 mile southeast of I. Crow No. 1 (M 51), on south side of Fish creek. Authority, Wheeling Natural Gas Co.

	Feet.		Feet.
Clay	0	to	15
Lime	15	to	40
Soapstone, lime, and slate	40	to	415
Mapletown coal, (Sewickley)	415	to	420
Lime and sand	420	to	516
Pittsburg coal	516	to	522
Coal, limestone, and sand	522	to	1380
Salt sand	1380	to	1460
Sand, lime, and shale	1460	to	1550
Limestone	1550	to	1640
Big Injun sand	1640	to	2040
Shale, slate, and sand	2040	to	2400
Red rock and shells	2400	to	2509
Gordon sand (gas)	2509	to	2528
Slate	2528	to	2529

Ellen Fleming No. 1 Well Record (M 96), Meade District.

Located on northeast side of Whetstone run, 1 mile and ¾ south of Meighen P. O.

Authority, Wheeling Natural Gas Co.

	Feet.		Feet.
Sand and lime	5	to	125
Coal, Washington	125	to	130
Limestone	130	to	445
Coal, Sewickley	445		
Sand and lime	445	to	535
Pittsburg coal	535		
Lime and red rock	535	to	930
Little Dunkard sand	930	to	970
Slate and sand	970	to	1040
Big Dunkard sand	1040	to	1070
Slate, shells, and sand	1070	to	1340
Salt sand	1340	to	1400
Slate and shells	1400	to	1590
Big lime	1590	to	1660
Big Injun sand	1660	to	1960
Gordon sand, gas	2530	to	2548

This well is located a short distance (200 yards) north of the Anderson core test well (M 95).

W. S. Howard No. 1 Well Record (M 97), Franklin District.

On Whetstone Run, ½ mile below E. Fleming No. 1 (M 96). Authority, Hope Natural Gas Co.

	Feet.		Feet.
Coal, Waynesburg	60	to	63
Coal, Mapletown (Sewickley)	264	to	268
Coal, Pittsburg	353	to	359
Salt sand	1075	to	1155
Big lime	1420	to	1470
Big Injun sand	1470	to	1753

	Feet	Feet.
Red rock	2180 to	2260
Gordon Stray sand	2332 to	2335
Gordon sand	2352 to	2369
Gas at 2359 to 2362 feet.		
Interval from top of **Pittsburg coal** to **Big Injun sand**	1117 feet.	
Interval from top of **Pittsburg coal** to **red rock**	1827 feet.	
Interval from top of **Pittsburg coal** to **Gordon Stray sand**	1979 feet.	
Interval from top of **Pittsburg coal** to **Gordon sand**	1999 feet.	
Thickness of the Monongahela series	299 feet.	

Northwest of the Lynn Camp gas field the Wheeling Natural Gas Co. drilled a couple of wells near the head of Lower Bowman Run on the Oscar Yeates and Daniel Jones farms, in which a light showing of both oil and gas was struck in the Big Injun sand.

Two dry holes have recently been drilled in the northern portion of Meade district along the ridge leading east and west, south of Grave Creek. One of these was drilled to a depth of 4206 feet. The records of both are of special scientific interest, and are as follows:

Mary V. Wilson No. 1 Well Record (M 39), Meade District.

Located ¾ mile southwest of Glen Easton. Authority, Hope Natural Gas Co.

	Feet	Feet
Coal, Waynesburg	650 to	656
Coal, Mapletown (Sewickley)	804 to	812
Coal, Pittsburg (steel line)	920 to	928
Little Dunkard sand **(I Cow Run)**	1252 to	1270
Big Dunkard sand	1320 to	1350
Gas sand, **Lower Freeport)**	1450 to	1560
Salt sand (water 1720)	1650 to	1840
Maxton sand	1961 to	1980
Big lime	2000 to	2015
Big Injun sand	2015 to	2300
Gordon sand (little gas at top)	2902 to	2934
Sand, Fourth	2990 to	3005
Sand, McDonald or Fifth	3115 to	3130
Sand, (Speechley? I or II Warren? Tiona?)	3550 to	3576
Slate and shells to bottom	3576 to	4206

The sand designated **Speechley? etc.,** coming 2630 feet below the top of the Pittsburg coal, and 648 feet below the top of the Gordon sand, appears to correlate with the horizon in which the **oil showing** was encountered in the Dobbs deep well (M 81). see page 392 for record. This well is located

nearly ½ mile west of a straight line joining the Dobbs deep well (M 81) and the Boggs Run deep well (M 7). With the exception of a light gas showing at the top of the Gordon sand, the Wilson well (M 39) was dry, and abandoned by the company. The other dry hole is located 2 miles west of the Wilson well and its record is as follows:

Gorby Heirs No. 1 Well (M 43), Meade District.

Located nearly 2 miles southeast of Rosby Rock. Authority, Wheeling Natural Gas Co.

	Feet		Feet.
Water	125	to	150
Coal, Washington	634	to	638
Coal, Waynesburg	724	to	729
Coal, Sewickley	955	to	961
Pittsburg coal	1040	to	1045
Big Dunkard sand	1550	to	1575
Gas sand (Lower Freeport)	1630	to	1690
Salt sand	1810	to	1980
Maxton sand	1990	to	2010
Lime	2100	to	2120
Big Lime	2125	to	2135
Big Injun sand	2150	to	2400
Berea sand	2768	to	2783
Gordon Stray sand	3003	to	3013
Gordon sand	3043	to	3060
Fourth sand, shells	3125	to	3130
Fifth sand, shells	3233	to	3236
Unrecorded	3236	to	3522

This well was dry and abandoned by the company.

Interval from top of **Pittsburg coal** to **Big Injun sand** .. 1110 feet.
Interval from top of **Pittsburg coal** to **Berea sand** ..... 1728 feet.
Interval from top of **Pittsburg coal** to **Gordon sand** .... 2003 feet.

CLAY DISTRICT.

Clay district, Marshall county, lies south of Moundsville and borders on the Ohio river. The only oil pool ever discovered within its area is the one heretofore mentioned just below the mouth of Grave Creek on the Ohio river front, where oil was found in both the **Murphy** and **Dunkard** sands, an account of which is found on page 341, under the general description of the latter formations. The following record of the Higgins No. 4 well (M 103), drilled near the summit of the river hill at the south side of this pool gives all three of the shallow sands, viz.: **Murphy, First Cow Run,** and **Dunkard**:

John Higgins No. 4 Well Record (M 103), Clay District.

Located 1 mile southwest of Moundsville. Authority, H. A. Hall, Contractor.

	Thickness. Feet	Bottom. Feet.
Conductor	8	8
Coal, Waynesburg	2	261
Lime at		300
Coal, Sewickley	6	446
Coal, Redstone	3	496
Coal, Pittsburg	6	518
Sand, Horseneck (Murphy)	55	680
Red rock at		690
Sand, First Cow Run	10	805
6¼ inch casing at		830
Black slate	50	880
Sand. Dunkard	28	988
Oil, 2 bbl. well at		970
Break		982
Sand (Salt?) at		1050
Show of oil		1075
Bottom of Salt sand		1400
4 ⅞" casing		1435
Pencil cave	10	1521
Big lime	45	1570
Keener sand	30	1600
Break, slaty	20	1620
Big Injun sand	32	1652
Gas at		1630
Salt water		1642
Total depth		1652

Shut down on sandstone on account of salt water.

Interval from top of **Pittsburg coal** to **Murphy sand** .... 112 feet.
Interval from top of **Pittsburg coal** to **I Cow Run Sand**.. 283 feet.
Interval from top of **Pittsburg coal** to **Dunkard sand** ... 448 feet.
Interval from top of **Pittsburg coal** to **Keener sand** ..... 1058 feet.

The **Keener** division of the Big Injun sand is well exhibited in this record.

The record of another well drilled 2 miles southwest of the Higgins well by the Scott Oil & Gas Co. is as follows:

Widow Beall No. 2 Well Record (M 104), Clay District.

Located on Butter Run, 2¾ miles north of Powhatan Station. Authority, H. A. Hall, Contractor.

	Thickness. Feet.	Depth. Feet.
Conductor	16	16
10 inch casing to bed rock		34
Coal, Mapletown (Sewickley)	6	76

	Thickness Ft.	Total Ft.
Coal, Pittsburg	7	143
Horseneck sand (Murphy)	20	240
Red rock		
Casing		310
First Cow Run sand	2	392
Red rock		
Dunkard sand	10	595
Sand	12	657
Salt sand	30	740
Black slate		790
Salt water at		930
Salt sand, bottom of at		985
Black slate.		
Maxton sand	10	1070
Black slate	87	1157
Big lime	48	1205
6¼ inch casing		
Keener sand	15	1230
Big Injun sand (steel line to top); water 1290	108	1338
Total depth (steel line)		1338

Still in sand and hole full of water.

The tidal elevation of the top of the hole at this well is about 650 feet, or nearly 50 feet higher than low water (600 A. T) at the Ohio river. Although the well was drilled in the gorge cut out by Butter Run, yet it took 34 feet of 10" casing to reach bed rock to shut off the old river deposit of gravel and debris.

In the extreme southeast corner of Clay district a dry hole (M 42) was drilled on the south side of the creek, 1-3 mile due west of Rosbys Rock, and the record of this well is found on page 87 in connection with the general section for Rosbys Rock.

On the Ohio side of the river at Powhatan Point, a 5-barrel well, reported in the **Maxton sand,** was brought in during 1908. The well is located on the river bank on the north side of Captina Creek. It is quite possible that this pool extends northeastward under the Ohio river into West Virginia. About 10 or 11 years ago according to Abram Dennis, a Steubenville, Ohio, company drilled a test well a short distance up Hog run on the Eva Sims land (M 106), in which a good showing of oil was encountered in the Big Injun sand as well as sufficient gas in a higher horizon to furnish the necessary fuel to finish drilling the well.

FRANKLIN DISTRICT.

The extreme southeast corner of Franklin district is crossed by the New Martinsville anticline along with its accompanying Gordon sand gas field. The following well record, ¾ mile north from the Marshall-Wetzel county line, and about the same distance southeast from Ella P. O. (Fairview), gives the succession in this portion of the county:

Jas. Henry No. 1 Well Record (M 117), Franklin District.

Location given above. Authority, Wheeling Natural Gas Co.

	Feet.		Feet.
Soil and clay	0	to	11
Soapstone, lime, and sand	11	to	358
Coal, Washington	358	to	362
Slate, shale, and lime	362	to	367
Mapletown coal (Sewickley)	677	to	682
Slate and shale	682	to	770
Pittsburg coal	770	to	778
Slate, lime, and sand	778	to	1162
Little Dunkard sand	1162	to	1187
Slate and shale	1187	to	1340
Gas sand	1340	to	1375
Lime, slate, and shale	1375	to	1570
Salt sand	1570	to	1620
Sand, slate, and shale	1620	to	1825
Big lime	1825	to	1880
Big Injun sand	1880	to	2160
Slate, lime, and shale	2160	to	2505
Berea Grit sand	2505	to	2515
Slate and shale	2515	to	2576
Red rock	2576	to	2656
Slate, sand, and shale	2656	to	2768
Gordon sand (gas)	2768	to	2786
Slate and shale to bottom	2786	to	2793

	Feet
Interval from top of **Pittsburg coal** to **Salt sand**	800
Interval from top of **Pittsburg coal** to **Big Injun sand**	1110
Interval from top of **Pittsburg coal** to **Berea sand**	1735
Interval from top of **Pittsburg coal** to **red rock**	1806
Interval from top of **Pittsburg coal** to **Gordon sand**	1998
Interval from top of **Big Injun sand** to **Gordon sand**	888

The following record is from a well drilled on Long run in July, 1903, on the western flank of the New Martinsville anticline:

P. P. Campbell No. 1 Well Record (M 113), Franklin District

Located 3 3-4 miles southeast of Franklin Station. Authority, Tri-State Gas Co.

	Top. Feet.	Bottom Feet
Native coal (Waynesburg "A")	210	....
Pittsburg coal	568	572
Big Dunkard sand? **(Salt)**	1440	....
Big Lime sand	1610	1669
Big Injun sand	1669	1917
No Berea sand		
No Gordon sand (sand shells)	2570	....
No Fifth sand		
Total depth (dry)	2805	

In the extreme southwest corner of Franklin district, there are 3 or 4 wells in the Big Injun sand. About 1 mile northeast of the Abersold pool occurs a small Big Injun sand well on the Richard Clark farm near the head of Sims run. It seems quite probable that these two pools are connected, and a well sunk between would be almost sure to find oil at the same horizon. Farther down Sims run, and one mile and a half southeast of Clarington station, still another Big Injun sand oil pool exists, consisting of 3 or 4 light wells. The structure seems favorable for a northeast extension of this pool along the west flank of the Proctor syncline, and there does not appear to have ever been any test wells drilled between this pool and Fish creek to condemn the intervening territory.

A dry hole was drilled on Connor run, 1 mile northeast of the mouth of Fish creek. It ended at a depth of 1800 feet or approximately 1600 feet below the Pittsburg coal, and hence did not reach the deeper sands below the Big Injun.

WETZEL COUNTY WELL RECORDS.

The accompanying table contains the abbreviated records of nearly 240 oil and gas wells and core test wells in Wetzel county as well as the levels above tide on several other wells of which the writer was unable to obtain a record or log at this time. As in the case of Marshall county, these records have been chosen on account of their wide dis-

tribution and in some cases on account of certain special features connected with the well, and all **diamond drill borings** have been listed as **core tests.** The wells have also been numbered from 1 up to **310,** and grouped entirely by districts, the serial number in each case corresponding to the number of the same well on the economic geology map accompanying this report in a separate cover (See explanations preceding table of Marshall county wells on page 362).

Under the column headed "Owner" in the table of wells for Wetzel county, the following abbreviations are used:

Alpha	Alpha Oil Company.
Bosher	Bosher & Co.
Brast	Brast et al.
Carnegie	Carnegie Natural Gas Company.
Carter	Carter Oil Company.
Chapman	Chapman & Trees.
Chartiers	Chartiers Oil Company.
Chiswell	Chiswell Oil Company.
Dakon	Dakon Oil Company.
Delmar	Delmar Oil Company.
Fisher	The Fisher Oil Company.
Hart, Cox	Hart, Cox et al.
H. & McNutt	Hervey & McNutt.
Hope	Hope Natural Gas Company.
Jennings	E. H. Jennings & Bros.
Jupiter	Jupiter Oil Company.
Kanawha	Kanawha Oil Company.
Melrose	Melrose Oil & Gas Company.
P & E	Parker & Edwards.
Philadelphia	Philadelphia Company.
Pure	Pure Oil Company.
Southern	Southern Oil Company.
South Penn	South Penn Oil Company.
Sun Oil & Gas	Sun Oil & Gas Company.
Syndicate	Syndicate Oil & Gas Company.
Tri-State	Tri-State Gas Company.
Wendell	Wendell Oil Co.
Wheeling	Wheeling Natural Gas Company.

In the elevation column the letter **B** indicates that the elevation of the top of the hole was obtained by aneroid checked on nearby U. S. G. Survey spirit level elevations; the letter L by spirit level measurement. Elevations are expressed in feet.

Summarized record of

No. on Map	NAME OF WELL	Location—District	Owner	Elevation
1	S. E. Anderson No. 1	Church	Philadelphia	1075B
2	Winona E. Shough No. 1	Church	South Penn.	1117L
3	J. Hostutler No. 1	Church	Fisher	1510B
4	John Santee No. 5	Church	Syndicate	1275B
5	Barney Sines No 1	Church	Eakin & Co.	1475B
6	Martha Six No. 1	Church	Carnegie	1571L
7	John H. Six No 1	Church	Cochran & Funk	1220B
8	John Hostutler No. 1	Church	Cochran & Funk	1105B
9	Jos. Phillips No. 1	Church	Philadelphia	1210B
10	Wm. Renner No. 1	Church	Wheeling	1150B
A10	David Hostutler No. 1	Church	Wheeling	1192L
11	K. Renner Heirs No. 1	Springhill	Wheeling	1115B
12	Wm. Johnson No. 1	Church	Philadelphia	1045B
13	Jas. Johnson No. 1	Church	Philadelphia	1110B
14	W. H Himelrick No. 1	Church	Philadelphia	1105B
15	H. Hixenbaugh No. 1	Church	Wheeling	1072B
16	S. J. Elliott No. 1	Church	Philadelphia	1032L
17	Geo. Kuhn No. 1	Church	Chaney & Brast	1170B
18	Samuel Himelrick No. 1	Church	Philadelphia	1050B
19	T. B. Hamilton No. 1	Church	Gibson & Giles	1015B
20	Bailey & Rice No 1	Church	Philadelphia Co.	1045B
21	W. G. Snodgrass No. 1	Church	Chartiers	1024L
22	G. F. Throckmorton No. 1	Church	Philadelphia	1040B
23	John A. Hoge No. 1	Church	Carnegie	1100B
24	R. Giblin core test	Church	J. V. Thompson	1040B
25	Moses Bartrug core test	Church	J. V. Thompson	1095B
26	W. C. Whitlatch No. 1	Church	Carnegie	1120B
27	J Bartrug No. 1	Church	Fisher	1170B
28	L. E. Pogue No. 1	Church	Carnegie	1110B
29	Jacob Liming No. 1	Church	Fisher	1370B
30	Sol Shriver No. 1	Church	Carter	1175B
31	Eugene Troy No. 1	Church	Philadelphia	1190B
32	Abe Bartrug No. 1	Church	Pure	1615B
33	Mark Hibbs No. 1	Church	Carnegie	1500B
34	W L. Cunningham No. 1	Church	Philadelphia	1170B
35	Mary A Wade No. 1	Church	Philadelphia	1190B
36	Joan Miner Hrs. No. 1	Church	Philadelphia	1155B
37	R. M. White No 1	Church	Philadelphia	1150B
38	Jno. Maple No. 4	Church	Fisher	1390B
39	W. G. Snodgrass No. 1	Church	Fisher	1370B
40	Mary Hunt No 1	Church	Carnegie	995B
41	R. H Haines No. 1	Church	Philadelphia	1180B
42	Jno. B Shriver No. 1	Church	Philadelphia	1000B
43	Wm. Devine No. 1	Church	Wheeling	1375B
44	G. W. Thomas No. 1	Church	Wheeling	1135B
45	Helena Taylor No. 1	Church	Philadelphia	1145B
46	Wm Teagarden No. 1	Church	Delmar	1085B
47	Wm. Teagarden No 1	Church	Philadelphia	1135B

Wells in Wetzel County.

PITTSBURG COAL			BIG INJUN SAND		GORDON SAND		Total Depth	Producing Sand	No. on Map
Depth (top	Elevat'n (top)	Thick-ness	Depth (top)	Thick-ness	Depth (top)	Thick-ness			
834	241	8	2093	232	2929	68	3068	Fourth	1
890	227	8	2134	248	2982	50	3189	Fourth	2
1313	197	6	2568	240	3438	24	3985	Big Injun	3
1085	190	.....	.....	.....	.....	.....	2263	Maxton	4
1244	231	7	2497	238	.....	.....	3431	Fourth	5
1348	223	7	.....	.....	.....	.....	.....	Fourth	6
990	230	.....	.....	.....	.....	.....	.....	Fourth	7
.....	.....	.....	.....	.....	.....	.....	.....	Fourth	8
1008	202	8	2250	210	3151	.....	3450½	Maxton	9
900	250	7	2140	280	.....	.....	3032	Gordon	10
962	230	5	.....	.....	.....	.....	1464	Big Dunkard	A10
901	215	.....	.....	.....	.....	.....	.....	.....	11
758	287	6	1996	224	.....	.....	.....	Big Injun	12
865	245	10	2115	231	.....	.....	3087	Gordon	13
785	320	5	2040	230	2885	57	3197	....	14
768	304	6	1950	245	2918	52	3371	Maxton and Fourth	15
735	297	5	1975	265	2850	50	2903	Maxton and Big Injun	16
.....	.....	.....	.....	.....	.....	.....	.....	.....	17
790	260	.....	.....	.....	.....	.....	.....	.....	18
700	315	8	.....	.....	.....	.....	.....	Pittsburg Coal Etc.	19
.....	.....	.....	.....	.....	.....	.....	.....	.....	20
719	305	7	.....	.....	.....	.....	.....	Maxton and Big Injun	21
727	313	8	1950	250	2829	55	3128	Maxton and Fourth	22
795	305	.....	.....	.....	.....	.....	.....	Big Injun	23
.....	.....	.....	.....	.....	.....	.....	.....	.....	24
855	240	.....	.....	.....	.....	.....	.....	.....	25
843	277	7	2065	244	2925	68	3279	Big Injun and Bayard	26
980	190	7	.....	.....	.....	.....	.....	....	27
939	171	.....	2178	115	.....	.....	2293	Big Injun	28
1195	175	5	2434	267	3228	35	3448	.....	29
1012	163	2	2280	255	.....	.....	3383	"30 Foot"	30
1007	183	.....	.....	.....	.....	.....	.....	Big Injun	31
1395	220	5	2535	.....	.....	.....	2553	Big Injun	32
1298	202	.....	.....	.....	.....	.....	.....	Big Injun	33
884	286	6	2168	217	.....	.....	3493	Big Injun	34
.....	.....	.....	.....	.....	.....	.....	.....	Big Injun	35
870	285	5	.....	.....	.....	.....	.....	Big Injun	36
850	300	.....	2090	.....	.....	.....	.....	Big Injun	37
1190	200	.....	.....	.....	.....	.....	.....	Maxton	38
1179	191	.....	.....	.....	.....	.....	.....	Maxton	39
691	304	.....	1926	254	2810	15	2971	"30 Foot"	40
858	322	7	2120	250	2938	25	3213	Gas Sand	41
732	268	8	1977	.....	.....	.....	.....	Big Injun	42
1055	320	7	2325	84	.....	.....	2419	Big Injun	43
835	300	.....	.....	.....	.....	.....	.....	Big Injun	44
840	305	8	2075	238	2955	35	3110	.....	45
840	245	.....	.....	.....	.....	.....	.....	.....	46
845	290	8	2105	220	2919	23	3012	Fourth	47

Summarized record of

No. on Map	NAME OF WELL	Location—District	Owner	Elevation
48	Wm. Teagarden No. 2	Church	Philadelphia	1150B
49	Hugh Cosgray No. 1	Church	Carter	1200B
50	Henry Shriver No. 1	Church	Hope	1160B
51	Hugh Cosgray No. 1	Church	Wheeling	1435B
52	Dennis Meighen No. 1	Clay	South Penn.	1325B
53	J. A. Conley No. 1	Clay	Philadelphia	1160B
54	Gorby Hrs. No. 1	Clay	Philadelphia	1200B
55	S. A. Carney core test	Clay	J. V. Thompson	930B
56	G. N. Gillingham No. 1	Clay	South Penn.	1452L
57	Jas. O'Day No. 1	Clay	Hope	1055B
58	W. P. Hubbard No. 1 (No. 84)	Clay	Philadelphia	970B
59	Geo. Church No. 1	Clay	Carnegie	995B
60	Peter Kiger No. 1	Clay	Carnegie	1115B
61	Enoch Anderson No. 1	Clay	Carnegie	965B
62	Harvey Villiers No. 1	Clay	Wheeling	970B
63	Jas. Clarke No. 1	Clay	Philadelphia	1180B
64	S. Newman No. 3	Clay	South Penn	1145B
65	Wm. Newman No. 3	Clay	South Penn.	1185B
66	Elsie Whitlatch No. 1	Clay	South Penn.	1050L
67	Eliza Anderson No. 1	Clay	Carnegie	1065B
68	Frank Wade No. 1	Center	South Penn.	1005B
69	Alfred Yoho No. 1	Center	Philadelphia	1180B
70	Ira Jolliffe No. 1	Center	South Penn.	1125B
71	Rufus Long No. 1	Center	Kanawha	994L
72	J. L Carney No. 1	Center	Kanawha	1075B
73	J. L. Carney No. 4	Center	Kanawha	1110B
74	Marion Gorby No. 1	Center	South Penn.	1215b
75	S. F. Higgins No. 1	Center	Kanawha	1220B
76	J. J. Morris No. 1	Center		1035B
77	H. Showalter No 1 (?)	Center	Philadelphia	1140B
78	Samuel Kirkpatrick No. 1	Center	Philadelphia	1015B
79	E. Sapp No. 1 (44A)	Center	South Penn.	1111L
80	Peter Glover No. 1	Center	South Penn.	1000B
81	Peter Glover No. 2	Center	South Penn.	1040B
82	Peter Glover No. 3	Center	South Penn.	1032L
83	A. W Showalter No. 1	Center	Philadelphia	1065B
84	S. H. Shriver No. 4	Center	South Penn.	1230B
85	W. J. Cross No 1	Center	Carter	1240B
A85	Amos Jolliffe No	Center	South Penn.	1035B
86	Z. T. Stewart No. 1	Center	Hope	1320B
87	David Sole No. 2	Center	Carter	1450B
88	John Lavelle No 1	Center	South Penn.	1085B
89	John Lavelle No. 2	Center	Hope	1115B
90	Chas. Anderson No. 1	Center	Hope	1145B
91	Elijah Bean No. 1	Center	Carnegie	1530B
92	Mary Lloyd No 1	Center	South Penn.	1500B
93	Wm. Hubbard No. 1830	Center	Philadelphia	1040B
94	Wm. Hubbard No. 1801	Center	Philadelphia	1410B

Wells in Wetzel County, (continued).

PITTSBURG COAL			BIG INJUN SAND		GORDON SAND		Total Depth	Producing Sand	No. on Map
Depth (top)	Elevat'n (top)	Thick-ness	Depth (top)	Thick-ness	Depth (top)	Thick-ness			
870	280	8	2155	220	2950	15	3028	Fourth	48
937	263	7	2142	211	3064	21	3293	.....	49
895	265	.....	.....	.....	.....	.....	.....	Gordon	50
1135	300	10	2387	240	3195	35	3597	Big Injun	51
1080	245	6	2335	255	3117	11	3424	Salt	52
885	270	8	2145	230	2962	31	3100	Fourth	53
894	306	10	2140	.....	.....	.....	.....	Salt	54
.....	.....	.....	.....	.....	.....	.....	.....	.....	55
1190	262	.....	2480	230	3286	46	3377	Fourth	56
795	260	6	2061	219	2887	16	2972	Fourth	57
660	310	.....	1930	.....	.....	.....	.....	.....	58
.....	.....	.....	.....	.....	.....	.....	.....	Gordon	59
835	280	8	2085	230	2908	24	3035	Gordon Stray	60
.....	.....	.....	.....	.....	.....	.....	.....	.....	61
660	310	8	1900	240	2758	23	2847	Salt and Fourth	62
883	297	.....	2130	.....	.....	.....	.....	.....	63
894	251	.....	2165	225	3007	23	3083½	Gordon and Fourth	64
932	253	.....	2206	234	3031	34	3118	Big Injun and Fourth	65
885	165	8	2150	250	.....	.....	.....	.....	66
812	253	.....	2050	.....	.....	.....	2150	Big Injun	67
840	165	5	2054	246	2880	25	2998	.....	68
930	250	7	2185	185	.....	.....	3223	.....	69
1025	100	5	2230	240	3054	21	3240	Maxton	70
.....	.....	.....	2063	.....	2895	20	2926	Big Injun	71
980	95	.....	2200	250	3010	23	3036	Gordon	72
992	118	.....	2280	220	3052	24	3077	Gordon	73
1131	84	6	2336	251	3174	21	3195	Gordon	74
1050	170	.....	2300	.....	.....	.....	3163	Gordon	75
.....	.....	.....	.....	.....	.....	.....	.....	.....	76
922	218	5	2160	.....	.....	.....	.....	Big Injun	77
825	190	.....	2036	.....	.....	.....	.....	Gordon	78
915	196	6	2140	260	.....	.....	.....	Gordon	79
781	219	.....	1998	.....	.....	.....	.....	.....	80
798	242	5	2020	250	.....	.....	2903	.....	81
785	247	5	.....	.....	.....	.....	.....	Big Injun	82
840	225	5	2110	.....	.....	.....	.....	.....	83
.....	.....	.....	.....	.....	.....	.....	.....	Gordon	84
992	248	6	2269	196	3078	12	3090	Gordon	85
785	250	.....	.....	.....	.....	.....	.....	Big Injun	A85
.....	.....	.....	.....	.....	.....	.....	.....	Big Injun	86
1189	261	6	2460	195	3263	.....	3290	Gordon	87
825	260	.....	.....	.....	.....	.....	.....	Big Injun	88
860	255	.....	2110	.....	.....	.....	.....	Big Injun	89
862	283	.....	.....	.....	.....	.....	.....	Big Injun	90
1270	260	.....	2555	199	3337	12	3512	.....	91
.....	.....	.....	.....	.....	.....	.....	.....	Big Injun	92
750	290	.....	2045	.....	.....	.....	.....	Big Injun	93
1130	280	.....	2410	.....	.....	.....	.....	Big Injun	94

Summarized record of

No. on Map	NAME OF WELL	Location—District	Owner	Elevation
95	A. C. Moore No. 3	Center	South Penn.	1335B
96	Jackson & Lambert No. 1	Center	South Penn.	1105B
97	Sarah Johnson No. 1	Center	South Penn.	1185B
98	Geo. B. Potts No. 1	Center	South Penn.	1030B
99	S. C. Miller No. 1	Center	South Penn.	1565B
100	T. J. Higginbotham No. 1	Center	South Penn.	915B
101	J. H. Rush No. 3	Center	Jennings	1535B
102	Morgan Dulaney No. 1	Center	South Penn.	915B
103	L. W. Postelthwait No.	Center	South Penn.	1140B
104	T. J. Showalter No. 1	Center	South Penn.	1280B
105	T. J. Showalter No. 2	Center	South Penn.	1185B
106	Jas. Morris No. 1	Center	Kanawha	955B
107	J. A. Lemasters No. 1	Center	South Penn.	1255B
108	Geo. Adams No. 1	Center	Kanawha	1495B
109	T. J Postlethwait No. 2	Center	South Penn.	1560B
110	Sidell-Moore No. 1	Center	South Penn.	1380B
111	John McElroy No. 2	Center	South Penn.	901L
112	Jupiter Oil Co. No. 3	Center	Jupiter	885B
113	M. Greathouse No. 1	Center	South Penn.	1140B
114	E Dakon No. 1	Center	Chiswell	845B
115	E. Dakon No. 2	Center	Dakon	806L
116	Jacob Yoho No. 1	Grant	South Penn.	1400B
117	Frank Blake No. 1	Grant	South Penn.	1555B
118	John Ingram No. 4 (?)	Grant	South Penn.	1070B
119	J. R. Shreeves No. 18	Grant	South Penn.	785L
120	J. R. Shreeves No. 14	Grant	Hope	780B
121	S. J. Long No. 1	Grant	South Penn.	780B
122	Presley Martin No. 1	Grant	South Penn.	915B
123	C. C. Long No. 1	Grant	South Penn.	760B
124	L. S. Hoyt No. 56	Grant	South Penn.	980B
125	Jacob Lantz No. 1	Grant	South Penn.	790B
126	Zue Lantz No. 2	Grant	South Penn.	745B
127	S. G Long No. 4	Grant	South Penn.	715B
128	J. N. Camden core test	Grant	J. N. Camden	695B
129	S L. Joliffe No. 1	Grant	Philadelphia	700B
130	E. Stackpole No. 1	Grant	Hope	885B
131	Samuel Morgan No. 1	Grant	Hope	1380B
132	F. M. Watson No. 1	Grant	Philadelphia	905B
133	A J. Lowe No. 1	Grant	Hope	737L
134	A. J. Lowe No. 1	Grant	South Penn.	720B
135	L Lacox No. 1 (No. 1607)	Grant	Philadelphia	825B
136	D. H. Cox No. 1	Grant	South Penn.	910B
137	R. DeGarmo No. 1	Grant	South Penn.	840B
138	R. Barr No 1610	Grant	Philadelphia	810B
139	D. McGildray No. 1 (1614)	Grant	Philadelphia	805B
140	S. B. Higginbotham No. 1	Grant	Hope	835B
141	J. P. Asheraft et al No. 1	Grant	Philadelphia	885B
142	F. B. Blake	Grant	Carnegie	1415B

Wells in Wetzel County, (continued).

PITTSBURG COAL			BIG INJUN SAND		GORDON SAND		Total Depth	Producing Sand	No. on Map
Depth (top)	Elevat'n (top)	Thick-ness	Depth (top)	Thick-ness	Depth (top)	Thick-ness			
1090	245	5	2340	250	.....	.....	.....	.....	95
.....	.....	.....	.....	.....	.....	.....	.....	.....	96
971	214	.....	2220	180	.....	.....	3059	Gordon	97
828	202	6	2070	230	.....	.....	2903	Gordon	98
1400	165	7	2620	270	3470	10	3480	Gordon	99
790	125	.....	2000	240	.....	.....	2860	Gordon	100
1410	125	.....	.....	.....	.....	.....	3460	Gordon	101
.....	.....	.....	.....	.....	.....	.....	.....	Gordon	102
1020	120	.....	.....	.....	.....	.....	.....	Gordon Stray	103
1160	120	8	2395	225	.....	.....	3208	Gordon Stray	104
1075	110	6	.....	.....	.....	.....	3162	Gordon Stray	105
880	75	.....	2096	249	2914	.....	2934	Gordon Stray	106
1100	155	5	.....	.....	.....	.....	.....	Gordon Stray	107
1439	56	.....	2640	240	3458	.....	3483	Gordon Stray	108
1437	123	.....	.....	.....	.....	.....	.....	Gordon Stray	109
1280	100	7	.....	.....	.....	.....	3358	Gordon Stray	110
835	66	5	2075	230	.....	.....	2881	Gordon Stray	111
825	60	.....	.....	.....	.....	.....	.....	Gordon Stray	112
1012	128	6	2210	290	.....	.....	3056	Gordon Stray	113
760	85	.....	.....	.....	.....	.....	.....	Gordon Stray	114
.....	.....	.....	.....	.....	.....	.....	.....	Gordon Stray	115
.....	.....	.....	.....	.....	.....	.....	.....	Gordon	116
1312	243	8	2550	220	3378	6	3392	Gordon Stray	117
.....	.....	.....	.....	.....	.....	.....	.....	Gordon	118
508	277	7	1761	237	2576	25	.....	Gordon	119
500	280	.....	1725	225	.....	.....	.....	Gordon	120
515	265	7	1780	220	.....	.....	2627	Gordon	121
.....	.....	.....	.....	.....	.....	.....	.....	Gordon	122
520	240	10	.....	.....	.....	.....	.....	Gordon	123
845	135	.....	2060	240	2871	24	2900	Gordon	124
570	220	6	1825	250	.....	.....	.....	Gordon	125
501	244	6	.....	.....	.....	.....	.....	Gordon	126
.....	.....	.....	.....	.....	.....	.....	.....	Gordon Stray	127
434	261	2	.....	.....	.....	.....	436?	.....	128
440	260	.....	1691	.....	.....	.....	.....	Gordon Stray?	129
.....	.....	.....	.....	.....	.....	.....	.....	Gordon Stray	130
.....	.....	.....	.....	.....	.....	.....	.....	Gordon stray	131
612	293	3	.....	.....	2698	18	2716	Gordon Stray	132
.....	.....	.....	.....	.....	.....	.....	.....	.....	133
425	295	5	1680	.....	.....	.....	.....	.....	134
.....	.....	.....	1915	135	2550	75	2750	Gordon	135
592	318	16	1872	151	.....	.....	3044	Maxton and Big Injun	136
535	305	7	1799	185	.....	.....	2895	.....	137
483	327	7	1730	.....	.....	.....	.....	Gordon Stray ?	138
.....	.....	.....	.....	.....	.....	.....	.....	Gordon Stray	139
525	310	12	.....	.....	.....	.....	.....	Gordon Stray	140
.....	.....	.....	.....	.....	.....	.....	.....	Gordon Stray	141
1150	265	.....	2386	214	3200	17	3217	Gordon Stray	142

Summarized record of

No. on Map	NAME OF WELL	Location—District	Owner	Elevation
143	L. Higginbotham No 1	Grant	Hope	845B
144	Israel Snyder No. 1	Grant	Philadelphia	840B
145	J. Province No. 1	Grant	Carter	(?)
146	J. C. Poe No. 1	Grant	South Penn.	1090B
147	W. Potts and F. F. Morgan No. 1	Grant	South Penn.	953L
148	A. Muffney No 1	Grant	Carter	941L
149	J. N. McDougal No. 1	Grant	South Penn.	895B
150	Jas. Shuman core test	Grant	Fairmont Coal Co.	871.4L
151	S. J. Kilcoyne No. 1	Grant	South Penn.	910B
152	Jas. Furbee No 1	Grant	Carnegie	980B
153	Jas. Allen No. 2	Grant	South Penn.	975B
154	Wm. Devore No. 2	Mannington	South Penn.	1395B
155	E. Batson No. 2	Grant	South Penn.	1290B
156	W. T. Price No. 2	Grant	South Penn.	1530B
157	W. H. Showalter No. 1	Grant	South Penn.	1555B
158	D. S. Norris No. 1	Grant	South Penn.	966L
159	I. D. Morgan No. 11	Grant	South Penn.	870B
160	F. C. Hays No. 3	Grant	South Penn.	850B
161	B. W. Peterson No 27	Grant	South Penn.	1360B
162	Elmer Ice No. 1	Grant	H. L. Smith	935B
163	L. G. Robinson and Hoge No.	Grant	South Penn.	935B
164	D. B. Ice No. 15	Grant	P. & E.	1250B
165	S. Cummings No. 1	Grant	.....	1490B
166	M. J. Kendall No. 2	Grant	Philadelphia	1020B
167	M. J. Kendall No. 3	Grant	Philadelphia	1070B
168	A. L. Wyatt No. 1	Grant	P. & E.	880B
169	Jno. Mills No. 1659	Grant	Philadelphia	840B
170	Jno. Willey No. 1	Grant	Carter	880B
171	Jno. Willey No 4	Grant	Carter	895B
172	Jno. Willey No. 2	Grant	Carter	1040B
173	G. W. T. Anderson No. 2	Grant	Carter	760B
174	G. W. T. Anderson core test	Grant	Zinn et al	750B
175	G. W. T. Anderson No. 4	Grant	Carter	735B
176	Wm. Wyatt No. 1	Grant	J. M. Guffey	785B
177	M. V. Anderson core test	Grant	Fairmont Coal Co.	763L
178	Lewis Wyatt No. 1	Grant	W. Clark	830B
179	G. W. Headley No. 1	Grant	Philadelphia	955B
	M. V. Anderson No 11	Grant	Carter	766L
	Samuel Lantz No. 1	Grant	Kanawha	750B
182	Samuel Lantz No. 8	Grant	Kanawha	768L
183	Jno. Mills No. 3	Grant	Kanawha	(?)
184	Jno. Mills No. 20	Grant	Kanawha	790B
185	Jno. Mills No. 88	Grant	Kanawha	805B
186	Jno. Mills No. 48	Grant	Kanawha	818B
187	Jno. Mills No. 68	Grant	Kanawha	820B
188	Jno. Mills No. 71	Grant	Kanawha	834L
189	Ezra Hays No. 1	Grant	Kanawha	(?)
190	Hart Bros. No 1	Grant	Kanawha	870

Wells in Wetzel County, (continued).

PITTSBURG COAL			BIG INJUN SAND		GORDON SAND		Total Depth	Producing Sand	No. on Map
Depth (top)	Elevat'n (top)	Thick-ness	Depth (top)	Thick-ness	Depth (top)	Thick-ness			
537	308	11	.....	.....	.....	.....	.....	Salt	143
540	300	.....	.....	.....	.....	.....	.....	....	144
1035	.....	15	2309	280	3100	5	3211	Gordon Stray	145
848	242	.....	2098	.....	.....	.....	.....	Big Injun	146
610	353	5	.....	.....	.....	.....	.....	Salt and Fourth	147
675	266	.....	1970	176	.....	.....	2146	Big Injun	148
.....	.....	.....	.....	.....	.....	.....	.....	....	149
602.4	269	7	.....	.....	.....	.....	610?	....	150
625	285	9	1909	.....	.....	.....	.....	....	151
612	368	.....	1900	110	2700	.....	2908	Salt and Big Injun.....	152
.....	.....	.....	.....	.....	.....	.....	.....	....	153
1180	215	7	2466	.....	.....	.....	2538	Big Injun	154
1045	245	8	2343	.....	.....	.....	2445	Big Injun	155
1224	306	7	2508	.....	.....	.....	2898	Big Injun	156
1290	265	.....	.....	.....	.....	.....	.....	Gordon Stray	157
740	226	10	2032	.....	.....	.....	2139	Big Injun	158
650	220	10	.....	.....	.....	.....	.....	Big Injun	159
612	238	6	1915	255	.....	.....	2750	Big Injun	160
1125	235	9	2439	.....	.....	.....	2534	Big Injun	161
718	217	8	.....	.....	.....	.....	.....	Big Injun	162
720	215	8	.....	.....	.....	.....	.....	....	163
.....	.....	.....	.....	.....	.....	.....	.....	Dunkard	164
1285	205	.....	.....	.....	.....	.....	.....	Big Injun	165
790	230	9	.....	.....	.....	.....	.....	....	166
819	251	14	.....	.....	.....	.....	.....	....	167
.....	.....	.....	.....	.....	.....	.....	.....	....	168
600	240	.....	1870	.....	.....	.....	.....	Big Injun	169
640	240	(2)	.....	.....	.....	.....	1838	Big Injun	170
644	251	8	1910	140	.....	.....	2870	Gordon	171
770	270	5	2000	240	2833	21	2879	Gordon	172
485	275	.....	1760	215	.....	.....	1860	Big Injun	173
503	247	2	.....	.....	.....	.....	.....	....	174
466	269	8	1700	250	2537	35	2590	Gordon	175
.....	.....	.....	.....	.....	.....	.....	.....	Gordon	176
522.8	240	(2)	.....	.....	.....	.....	605?	....	177
.....	.....	0	.....	.....	.....	.....	.....	....	178
(760)	(195)	.....	2050	175	2813	10	2965	....	179
520	246	5	1780	200	2596	33	2643	Gordon	180
477	273	.....	1755	210	.....	.....	2664	Gordon	181
458	310	.....	1773	222	2568	25	2604	Big Injun and Gordon....	182
590	.....	.....	1895	230	2670	.....	2752	Gordon	183
535	255	.....	1835	.....	2632	.....	2652	Big Injun and Gordon	184
582	223	.....	1880	200	2668	29	2703	Gordon	185
615	203	.....	1930	.....	2688	.....	2706	Gordon	186
618	202	.....	.....	.....	2699	26	2728	Gordon	187
630	204	.....	1940	195	2730	25	2773	Gordon	188
877	.....	1	2180	195	.....	.....	3112	Gordon	189
635	235	.....	1981	197	2759	29	2799	Gordon	190

Summarized record of

No. on Map	NAME OF WELL	Location—District	Owner	Elevation
191	Hart Bros. No. 6	Grant	Kanawha	895
192	J. B. Dewhurst Hrs. No. 21	Grant	South Penn.	920B
193	J. B. Dewhurst Hrs. (No. 29)	Grant	South Penn.	1040B
194	J. B. Dewhurst Hrs. No. 1	Grant	South Penn.	1350B
195	L. G. Robinson No 17	Grant	South Penn.	1455B
196	Catherine Carlin No. 1	Grant	South Penn.	1105B
197	Catherine Carlin No. 2	Grant	South Penn.	1050B
198	Blackshere, Wells & Co. No. 5	Grant	South Penn.	930B
199	Cassa Dawson No. 7	Grant	South Penn.	1150B
200	J. B. Dewhurst No. 26	Grant	South Penn.	910B
201	Pat Carlin No. 1	Grant	South Penn.	880B
202	J. B. Dewhurst No. 27	Grant	South Penn.	975B
203	L. G. Robinson No. 13	Grant	South Penn.	885B
204	Jno. Stevens No. 20	Grant	South Penn.	1390B
205	C. S. Lowe No. 1	Grant	Sun Oil & Gas	835B
206	Jno. Stevens No. 8	Grant	South Penn.	830B
207	H. L. Smith No. 1	Grant	Wheeling	1070B
208	J. S. Stout No. 2	Grant	South Penn.	1025B
209	J. W. Starkey No. 1	Grant	South Penn.	860B
210	J. W. Starkey No. 4	Grant	South Penn.	880B
211	H. Talkington No. 5	Grant	South Penn.	920B
212	D. Talkington No. 1	Grant	South Penn.	960B
213	Catherine Ice No. 1	Grant	South Penn.	992L
214	Taylor Ruble No. 1	Grant	Carnegie	1015B
215	M. P. Dye No. 8	Grant	South Penn.	1050B
216	Jesse Ashcraft No. 5	Grant	South Penn.	1140B
217	F. Dye et al No. 1	Grant	Carnegie	1210B
218	G. W. Dye No. 1	Grant	Carnegie	1350
219	Elma J. Bates No. 1	Grant	Carnegie	1260B
220	Mary Starkey No. 1	Grant	South Penn.	1000B
221	John Price No. 3	Grant	South Penn.	1445B
222	Perry Hall No. 3	Grant	South Penn.	1585B
223	Cephus Higgins No. 2	Grant	South Penn.	1215B
224	Wm. Price No 1	Grant	South Penn.	1005B
225	Hall Price No 3	Grant	South Penn.	947L
226	S. Jones Long No. 1	Green	Kanawha	875B
227	John Cosgray No. 1	Green	Kanawha	1060B
228	Brown coal test	Green	S. W. Meals	905B
229	Jesse Eakin No. 1	Green	South Penn.	1325B
230	T. H. Alley No. 1	Green	South Penn.	1000B
231	F. C. Headley et al (now B. L. Morg.)	Green	J. N. Camden	694L
232	Friend Headley No. 1	Green	Philadelphia	1150B
233	John Lantz No 1	Green	Carnegie	720B
234	Lot Martin No. 1	Green	Tri-State	745B
[illegible]	Asbury Passett No. 1	Green	Hope	800B
[illegible]	T. Cunningham No 1	Green	Hope	730B
237	T. M. Cunningham No. 1	Green	Hope	770B
238	L. J. Flaharty No. 3	Green	South Penn.	765B

Wells in Wetzel County, (continued).

PITTSBURG COAL			BIG INJUN SAND		GORDON SAND		Total Depth	Producing Sand	No. on Map
Depth (top)	Elevat'n (top)	Thick-ness	Depth (top)	Thick-ness	Depth (top)	Thick-ness			
667	228	.....	.....	.....	.....	.....	1878	Maxton	191
720	200	3	2068	112	.....	.....	3077	Gordon	192
.....	....	.....	.....	.....	.....	.....	.....	....	193
.....	.....	.....	.....	.....	.....	.....	.....	Big Injun	194
.....	.....	.....	.....	.....	.....	.....	.....	Big Injun	195
760	345	8	2071	.....	.....	.....	2012	Big Injun	196
674	376	8	2010	.....	.....	.....	2180	Big Injun	197
650	280	10	2005	138	.....	.....	2143	Big Injun	198
857	293	6	.....	.....	.....	.....	.....	....	199
657	253	4	2012	.....	.....	.....	2076	Big Injun	200
.....	.....	.....	.....	.....	.....	.....	.....	Big Injun	201
752	223	3	2087	128	.....	.....	3149	Big Injun	202
.....	.....	.....	.....	.....	.....	.....	.....	Big Injun	203
1130	260	7	2430	.....	.....	.....	2539	Big Injun	204
583	252	7	.....	.....	.....	.....	.....	....	205
.....	.....	.....	.....	.....	.....	.....	.....	Big Injun	206
760	310	11	2065	180	2851	12	2882	Big Injun and Gordon	207
825	200	6	2143	120	2953	12	2973	Big Injun and Gordon	208
642	218	10	1954	.....	.....	.....	2029	Big Injun	209
664	216	11	1990	.....	.....	.....	2065	Big Injun	210
778	142	4	2065	90	2868	17	2898	Gordon	211
836	124	7	2115	85	2916	13	2932	Gordon	212
.....	.....	.....	.....	.....	.....	.....	.....	Gordon	213
810	205	.....	2100	80	2880	.....	.....	Gordon Stray	214
890	190	6	2076	106	2967	19	.....	Gordon	215
.....	.....	.....	.....	.....	.....	.....	.....	Gordon	216
960	250	.....	.....	.....	.....	.....	.....	Gordon	217
1097	253	5	2355	145	3161	20	3195	Stray and Gordon	218
955	305	.....	2245	105	.....	.....	3041	Big Injun and Stray	219
924	76	8	2200	100	2980	.....	3013	Stray and Gordon	220
1222	223	8	2522	87	.....	.....	.....	Gordon	221
1440	145	6	2745	135	.....	.....	3594	Gordon	222
1064	151	6	2350	145	3165	.....	3202	Gordon	223
.....	.....	.....	.....	.....	.....	.....	.....	Gordon	224
834	113	8	2130	125	2938	15	2957	Stray and Gordon	225
760	115	.....	1949	226	.....	0	3350	Gordon Stray	226
.....	.....	.....	.....	.....	.....	.....	.....	Gordon Stray	227
(580)	(325)	.....	.....	.....	.....	.....	530	....	228
.....	.....	.....	.....	.....	.....	.....	.....	Gordon Stray	229
745	255	5	2000	240	.....	.....	2822	Gordon Stray	230
(441)	(247)	2	.....	.....	.....	.....	.....	....	231
.....	.....	.....	.....	.....	.....	.....	.....	Gordon Stray	232
480	240	.....	1745	255	2553	17	2850	....	233
390	355	.....	1695	245	2508	.....	2537	Big Injun	234
446	354	10	.....	.....	.....	.....	.....	Gordon Stray	235
.....	.....	.....	.....	.....	.....	.....	.....	....	236
.....	.....	.....	.....	.....	.....	.....	.....	....	237
518	247	.....	.....	.....	.....	.....	.....	Big Injun	238

Summarized record of

No. on Map	NAME OF WELL	Location - District	Owner	Elevation
239	Rachael Wright No. 6	Green	South Penn.	857L
240	Rachael Wright No. 3	Green	South Penn.	856L
241	Racheal Wright No. 4	Green	South Penn.	856L
242	Sol H. Wiley No. 1	Green	South Penn.	823L
243	E. A. Booth No. 4	Green	South Penn.	900B
244	Geo. V. Reilly No. 1	Green	South Penn.	901L
245	Henry Nolan No. 7	Green	South Penn.	941L
246	Henry Nolan No. 2	Green	South Penn.	955B
247	E. B. Lemasters No. 5	Green	South Penn.	1031L
248	Wm. Fluharty No. 9	Green	South Penn.	1020B
249	D. M. Cunningham No. 4	Green	South Penn.	910B
250	David Fluharty No. 2	Green	South Penn.	860B
251	J. R. Haught No. 1	Green	Carnegie	1205B
252	Chas. Wendell No. 1	Green	Tri-State	843L
253	Wm. Kennedy No. 1	Green	Tri-State	1195L
254	Rebecca Pittman No. 1	Green	H. & McNutt	1205B
255	Thos. O'Brien No. 2	Green	Tri-State	750B
256	Thos. O'brien No. 1	Green	Tri-State	735B
257	J. R. Woods No. 2	Green	Hope	(——)
258	Ida Cochran No. 1	Green	H. & McNutt	1280B
259	Ida Cochran No. 2	Green	H. & McNutt	1270B
260	Morgan Morgan No. 1	Green	Philadelphia	685B
261	Ed Winning No. 1	Green	Shay et al	700B
262	Ed E. Winning No. 1766	Green	Philadelphia	795B
263	Abrigg No. 1	Green	Wendell	945B
264	Morgan Morgan No. 2	Green	Philadelphia	660B
265	W. A. Morgan No. 1	Green	Thos. Mills	675B
266	Rebecca Wright No. 1	Green	(————)	700B
267	J. A. Steel No. 1	Green	Hart, Cox	675B
268	Wm. Hart No. 1	Green	Brast	690B
269	Steel core test	Green	Kauffman	685B
270	John Siedler No. 1	Proctor ...	South Penn.	885L
271	A. G. Calvert No. 1	Proctor ...	South Penn.	1095B
272	Geo. Hermann No. 1	Proctor ...	Hope	———
273	Jacob Higgins No. 1	Proctor ...	South Penn.	1150B
274	Susan Cain No. 1	Proctor ...	Chapman	1060B
275	Geo. Dunham No. 1	Proctor ...	South Penn.	.....
276	David Carpenter No. 1	Proctor ...	Kanawha	875B
277	J. L. Kirtland No. 1	Proctor ...	Kanawha	765B
278	Nippert No. 1	Proctor ...	Alpha	.....
279	Geo. W. Cook No. 1	Proctor ...	Bosher	770B
280	J. A. Kocher No. 1	Proctor ...	Carr Bros.	750B
281	J. A. Kocher core test	Proctor ...	Kauffman	740B
282	Fred Thomas No. 1	Proctor ...	South Penn.	860B
283	Anna Brachbuhler No. 1	Proctor ...	Pure	980B
284	John Trader No. 1	Proctor ...	Tri-State	779L
285	J. W. O'Neil No. 1	Proctor ...	Tri-State	750B
286	Jno. Hayford No. 1	Proctor ...	South Penn.	1005B

Wells in Wetzel County, (continued).

PITTSBURG COAL			BIG INJUN SAND		GORDON SAND		Total Depth	Producing Sand	No. on Map
Depth (top)	Elevat'n (top)	Thick-ness	Depth (top)	Thick-ness	Depth (top)	Thick-ness			
620	237	.....	1850	270	.....	.....	.....	Big Injun	239
624	232	.....	1949	150	.....	.....	.....	Big Injun	240
600	256	.....	1925	150	.....	.....	.....	Big Injun	241
570	253	.....	.....	.....	2625	.....	2665	Gordon	242
659	241	.....	.....	.....	2735	18	2753	Gordon	243
668	233	.....	1995	105	2742	8	2805	Gordon	244
765	176	.....	2090	135	2834	.....	2869	Gordon	245
754	201	.....	2079	150	2850	17	2895	Gordon	246
833	198	.....	2123	247	2920	12	2940	Gordon	247
780	240	.....	2107	165	2856	15	3210	Gordon	248
645	265	.....	1950	200	2755	14	2780	Gordon	249
614	246	.....	1910	260	2709	16	2728	Gordon	250
.....	.....	.....	.....	.....	.....	.....	2974	Gordon Stray	251
.....	.....	.....	.....	.....	.....	.....	.....	Gordon Stray	252
880	315	1	2180	220	2936	29	3005	Gordon	253
885	.....	7	.....	.....	.....	.....	.....	Big Injun	254
444	306	.....	1729	121	.....	.....	2603	Gordon Stray	255
427	308	.....	1705	.....	.....	.....	.....	Gordon Stray	256
925	.....	2	2177	233	3004	29	3625	Gordon	257
.....	.....	.....	.....	.....	.....	.....	.....	Big Injun	258
.....	.....	.....	.....	.....	.....	.....	.....	Big Injun	259
460	225	.....	1750	.....	.....	.....	.....	Big Injun	260
.....	.....	.....	.....	.....	.....	.....	.....	Big Injun	261
555	240	5	1772	245	2618	1	.....	Big Injun	262
704	241	5	.....	.....	.....	.....	1802½	Maxton	263
420	240	4	1640	260	.....	.....	.....	....	264
.....	.....	.....	.....	.....	.....	.....	.....	....	265
.....	.....	.....	.....	.....	.....	.....	.....	....	266
.....	.....	.....	.....	.....	.....	.....	.....	....	267
533	157	(2.8)	.....	.....	.....	.....	1910	....	268
.....	.....	2.8	.....	.....	.....	.....	.....	....	269
.....	.....	.....	.....	.....	.....	.....	.....	....	270
.....	.....	.....	.....	.....	.....	.....	.....	....	271
.....	.....	.....	.....	.....	.....	.....	.....	....	272
.....	.....	.....	.....	.....	.....	.....	.....	....	273
.....	.....	.....	.....	.....	.....	.....	.....	....	274
1111	.....	6	2320	240	3165	13	3319	....	275
790	85	.....	1990	210	.....	.....	2882	Gordon Stray	276
680	85	.....	1850	225	2730	12	2878	....	277
622	.....	.....	1814	.....	.....	.....	.....	....	278
585	185	.....	.....	.....	.....	.....	.....	Big Injun	279
540	210	(2)	.....	.....	.....	.....	.....	Big Injun	280
(530)	.....	2.8	.....	.....	.....	.....	.....	....	281
.....	.....	.....	.....	.....	.....	.....	.....	....	282
780	200	12	.....	.....	.....	.....	.....	....	283
440	339	.....	1570	240	2455	12	2467	Gordon	284
405	345	.....	1548	308	2412	5	2417	....	285
740	265	7	.....	.....	.....	.....	.....	Gordon	286

Summarized record of

No. on Map	NAME OF WELL	Location—District	Owner	Elevation
287	F. M. Huggins No. 1 (7½A)	Proctor	J. Stamm & Co.	995B
288	Jno. Huggins No. 4	Proctor	Iseman O. Co.	1025B
289	Henry Garner No. 23	Proctor	South Penn.	1345b
290	H. R. Thompson No. 1	Proctor	South Penn.	1435B
291	Jas. Henry No. 2	Proctor	Hope	1050B
292	Robt. Coffield No. 3	Proctor	Hope	1385B
293	J. M. Parsons No. 369	Proctor	Hope	1368L
294	Maria Parsons No. 2	Proctor	Hope	1305B
295	Jacob Yoho No. 1	Proctor	Wheeling	1225B
296	Mack Goudy No. 1	Proctor	Tri-State	770B
297	John Moore No. 1	Proctor	J. Trees	655B
298	John Witmer No. 1	Magnolia	South Penn.	970B
299	Ed Wagner No. 1	Magnolia	Ed Wagner	880B
300	Ed Wagner core test	Magnolia	J. M. Hall	880B
301	V. Stanaford No. 1	Magnolia	.....	955B
302	Samuel Martin No. 1	Magnolia	Tri-State	715B
303	J. C. Wise No. 1	Magnolia	Tri-State	630B
304	A. Morgan No. 1	Magnolia	Tri-State	640B
305	J. Bauman core test	Magnolia	J. C. Neff	630B
306	W. W. Givens No. 1	Magnolia	M. B. Potts	1080B
307	J. M. Vancamp No. 2	Magnolia	Southern	775B
308	Z. S. Watkins No. 1	Magnolia	Melrose	765B
309	E. K. Pollock core test	Magnolia	McGrew Bros.	615B
310	A. N. Vancamp No. 1	Magnolia	Pure	(——)

Wells in Wetzel County, (continued).

PITTSBURG COAL			BIG INJUN SAND		GORDON SAND		Total Depth	Producing Sand	No. on Map
Depth (top)	Elevat'n (top)	Thick-ness	Depth (top)	Thick-ness	Depth (top)	Thick-ness			
728	267	7	.....	.....	.....	.....	.....	Gordon	287
745	280	.....	1880	300	2768	8	2776	Gordon	288
1040	305	4	2190	268	.....	.....	3067	Gordon	289
1155	280	6	2270	315	.....	.....	3194	Gordon	290
740	310	.....	.....	.....	.....	.....	.....	Gordon	291
.....	.....	.....	.....	.....	.....	.....	.....	Gordon	292
960	408	.....	.....	.....	.....	.....	.....	Gordon	293
.....	.....	.....	.....	.....	.....	.....	.....	Gordon	294
810	415	5	1895	315	2813	49	2862	Gordon	295
370	400	.....	1510	310	2360	10	2370	Gordon	296
.....	.....	.....	.....	.....	.....	.....	.....	....	297
.....	.....	.....	.....	.....	.....	.....	.....	....	298
(645)	(235)	0	1780	175	.....	.....	2371	....	299
.....	.....	.....	.....	.....	.....	.....	430.3	....	300
.....	.....	.....	.....	.....	.....	.....	.....	....	301
430	285	.....	1550	200	2380	7	3120	....	302
453	177	.....	1600	210	.....	.....	3014	....	303
.....	.....	.....	.....	.....	.....	.....	.....	Keener	304
.....	.....	(3 ?)	.....	.....	.....	.....	.....	....	305
.....	.....	.....	.....	.....	.....	.....	.....	....	306
.....	.....	.....	.....	.....	.....	.....	.....	Keener	307
(500)	(265)	.....	1675	.....	.....	.....	1726	....	308
.....	.....	.....	.....	.....	.....	.....	440	....	309
(800)	.....	.....	1982	.....	.....	.....	2014	Keener	310

The foregoing table of the abbreviated records of important wells in Wetzel county is very convenient for ready reference, but, as in the case of Marshall county, it is very important that the complete record of a number of these wells be published not only to preserve them from loss, but for the great fund of information they contain as to **other coals** than the Pittsburg bed, as well as **other oil and gas** horizons than the Big Injun and Gordon sands. The accurate location of any well is readily determined by its serial number, published both with the record and on the economic geology map accompanying this report in a separate cover.

Wetzel county probably has produced more oil and gas than any other county of the State. Both have been found in every magisterial district in the county. Grant district, in the southeastern corner of the county, takes the lead in production and Magnolia district, along the Ohio river front, brings up the rear.

The well records and discussion of the various fields will now be taken up in geographic order or by magisterial districts in Wetzel county.

CHURCH DISTRICT.

Church district lies in the extreme northeast corner of Wetzel county, and is crossed in a northeast-southwest direction by two structural folds; viz., the Hundred anticline and the Burchfield syncline, rendering conditions very favorable from a structural standpoint for the accumulation of oil and gas. This district has probably a greater diversity of oil and gas horizons than any other in the State, since oil or gas has been produced within the boundary of this district from the **Dunkard, Gas (Lower Freeport), Salt, Maxton, Big Injun, Thirty-foot, Gordon Stray, Gordon,** and **Fourth** sands.

In the extreme northeast corner of Church district there has been opened up a fine **Fourth sand** oil pool that is sometimes referred to as the "Hixenbaugh field." One of the wells on the Hixenbaugh farm in this field had an initial production of over 1,000 barrels per day. The records of the

following wells, 4 in number will suffice to show the position of the Fourth sand as well as other strata of economic importance.

Barney Sines No. 1 Well Record (W 5), Church District.

Located on head of Cappo run of Church fork, 1 mile Northwest of St. Cloud P. O. Authority, Eakin & Co.

	Feet.	Feet
Coal, Mapletown (Sewickley)	1150	
Coal, Pittsburg (steel line)	1244 to	1251
Reds	2332 to	2357
Maxton sand	2357 to	2417
Pencil cave	2417 to	2425
Big lime	2425 to	2497
Big Injun sand	2497 to	2735
"Fifty-foot" sand	3207 to	3265
"Thirty-foot" sand	3267 to	3317
Slates	3317 to	3319
Gordon sand	3319 to	3343
Slate and shells	3343 to	3391
Fourth sand	3391	
Oil at	3413	
Total depth		3431

The initial production of the well was 35 barrels per day from the Fourth sand, the top of which comes 2147 feet below the top of the Pittsburg coal. The same interval for several wells in this region ranges from 2150 to 2190 feet. The detailed log of the Sarah Anderson No. 1 well (W 1), published on page 110, gives 2188 feet for this interval. The following record of the Winona Shough well No. 1 (W 2), located 3-4 miles N. 70° E. of the Anderson No. 1 (W 1) and published in Vol. I (a), p. 178 of the State reoprts, gives 2182 feet for this interval:

Winona Shough No. 1 Well Record (W 2), Church District.

Located 1.5 mile Northeast of Burton. Authority, South Penn Oil Co.

	Feet.	Feet
Bluff sand	515 to	545
Coal, Waynesburg	545 to	550
Sand	605 to	618
Mapletown coal (Sewickley)	787 to	792
Pittsburg Coal	890 to	898
Red rock	1155 to	1185
Slate and lime	1185 to	1260

	Feet.		Feet
Little Dunkard Sand (I Cow Run)	1260	to	1295
Big Dunkard Sand	1365	to	1395
"Gas" Sand (II Cow Run)	1660	to	1775
Salt Sand (little gas 1875')	1790	to	1896
Maxton Sand (oil show 2030')	1984	to	2059
Pencil cave	2059	to	2069
Big Lime	2069	to	2134
Big Injun Sand	2134	to	2382
Sand, Berea?	2482	to	2582
"Fifty-foot" Sand	2800	to	2850
"Thirty-foot" Sand	2894	to	2926
Gordon "Stray" Sand	2934	to	2957
Little gas and oil show, 2944'.			
Sand, very hard }	2982	to	3032
Sand, good..... } **Gordon**	3040	to	3070
Sand, hard (Fourth)	3072	to	3090
Sand (Fifth)	3106	to	3124
Slate and shells to bottom	3124	to	3189

In this well a showing of oil was found in both the **Maxton** and **Gordon Stray** sands, as well as a little gas in the **Salt sand**. The exact thickness of the Monongahela series here is shown to be 353 feet, and a good thickness of the **Waynesburg, Sewickley,** and **Pittsburg** coals. The Gordon sand appears to be split into two divisions by 8 feet of slate. The Anderson (W 1) well, 3-4 miles below, shows 68 feet of Gordon sand without a break, thus making it seem quite probable that a split has occurred in the Gordon at the Shough well, since there is a difference of only 6 feet in the interval from the top of the Pittsburg coal to the Fourth sand in both wells.

Jackson Hostutler No. 1 Well Record (W 3), Church District.

Located 2 miles Northeast of Burton on head of Church fork, and 6-10 of a mile east of Shough No. 1 well (W 1). Authority, Fisher Oil Co.

	Feet.		Feet
"Bluff" Sand	926	to	966
Waynesburg Coal	972	to	974
Mapletown Coal	1218	to	1222
Pittsburg Coal	1313	to	1319
Little Dunkard Sand	1725	to	1765
Big Dunkard Sand	1789	to	1867
Sand	1998	to	2082
"Gas" Sand	2105	to	2185
Salt Sand (little gas, 2298')	2296	to	2316

	Feet.	Feet
Pencil cave	2504 to	2508
Big Lime	2508 to	2568
Big Injun Sand (gas, 2573′ and oil at 2588′)	2568 to	2808
Fifty-foot Sand	3274 to	3330
Sand	3334 to	3354
Red rock	3364 to	3370
Gordon "Stray"	3384 to	3402
Sand, Gordon	3438 to	3462
Sand	3472 to	3490
Sand (Fourth)	3516 to	3530
Sand (Fifth)	3570 to	3585
Lime	3810 to	3813
Hard lime	3828 to	3845
Slate to bottom	3845 to	3985
Interval from top of **Pittsburg coal** to **Big Injun sand**		1255
Interval from top of **Pittsburg coal** to **red rock**		2051
Interval from top of **Pittsburg coal** to **Gordon sand**		2125
Interval from top of **Pittsburg coal** to **Fourth sand**		2203
Interval from top of **Pittsburg coal** to **Fifth sand**		2257

Jos. A. Phillips No. 1 Well Record (W 9), Church District.

One mile north of Round Bottom. Authority, Philadelphia Company.

	Feet.	Feet
Coal, Washington	505 to	510
Coal, Waynesburg	665 to	670
Coal, Pittsburg (little gas)	1008 to	1016
Salt Sand	1870 to	2005
Maxton sand (show of gas)	2115 to	2165
Big lime	2193 to	2250
Big Injun sand	2250 to	2460
Gantz sand	2930 to	2954
"Fifty-foot" sand	2962 to	3000
"Thirty-foot' sand	3043 to	3060
Gordon Stray sand	3151	
Gordon sand	3180 to	3202
Fourth sand	3225 to	3250
Fifth sand	3285 to	3292
Slate to bottom	3292 to	3450½

Completed October 5, 1899. Dry hole.

This well penetrated 2448½ feet below the top of the Pittsburg coal, or below the horizon of the Bayard sand. The latter does not appear to be present at this locality. The interval from the top of the Pittsburg coal to the Gordon sand, 2178 feet, seems excessive.

Wm. Renner No. 1 Well Record (W 10), Church District.

Located½ mile west of Phillips No. 1 (W 9) and 1 mile N. of Round Bottom. Authority, Wheeling Natural Gas Co

	Feet		Feet.
Mapletown coal (Sewickley)	800	to	805
Pittsburg coal (some water)	900	to	907
Little Dunkard sand (I Cow Run)	1300	to	1320
Big Dunkard sand	1400	to	1490
Gas sand	1580	to	1635
Salt sand	1680	to	1780
Salt sand	1810	to	1920
Maxton sand	2000	to	2070
Pencil cave	2070	to	2072
Big lime	2072	to	2140
Big Injun sand	2140	to	2420
Fifty-foot shells	2700	to	2760
Thirty-foot and Gordon Stray? sands (gas at 2965')	2900	to	3004
Gordon Sand	3010	to	3020
Unrecorded	3020	to	3032

The same company brought in a **Dunkard sand oil well** during 1908 on the David Hostutler farm, ¼ mile northeast of the Renner well above. Its record is as follows:

David Hostutler No. 1 Well Record (M 10A), Church

Located on Left fork of Cappo run, 1¼ miles N. of Round Bottom P. O. Authority, Wheeling Natural Gas Co.

	Feet		Feet.
Large amount of water at 110 feet.			
Mapletown coal (Sewickley)	660	to	664
Pittsburg coal	962	to	967
Little Dunkard **(I Cow Run sand)**	1280	to	1290
Big Dunkard sand (Mahoning)	1440	to	1464
First oil pay at	1443		
Second oil pay at	1450		

Initial production was 18 to 20 barrels per day. This oil horizon evidently represents the true Dunkard sand, coming as it does 478 feet below the top of the Pittsburg coal, and correlates with one of the Mahoning sandstones of the Conemaugh series. The writer collected a fresh sample of this oil, soon after the well was drilled in, that registered 51° Baume.

In the eastern part of Church district there occurs a fine **Maxton sand oil** pool, consisting of 40 to 50 wells, on the

Santee, Lemmons, Maple and other farms. This pool has its southern terminus near Lost run of Fish creek and runs almost due north, nearly parallel with the 250-foot structure contour of the Pittsburg coal, 1 mile westward. The records of the following wells, 4 in number, show the position of the producing sand with reference to other strata:

John Santee[17] No. 5 Well Record (W 4), Church District.

Location on Little Rush run, 1 mile northeast of Burton. Authority, J. P. Hagan, Hero, Pa., of Syndicate Oil & Gas Co.

	Feet.	Feet.	
Wood conductor		15	
Pittsburg Coal	1085		
Little Dunkard Sand (I Cow Run)	1475 to	1520	
Big Dunkard Sand	1835 to	1900	
"Gas" Sand (little salt water)	1835 to	2100	(?)
Salt Sand	2025 to	2100	
Red rock	2120 to	2183	
Maxton Sand	2183 to	2263	
First show of oil	2118		
More oil at	2225		
Best "pay" at	2242		
Total depth of well	2263		

The **Maxton sand** is here shown to be 80 feet in thickness, coming 1098 feet below the top of the Pittsburg coal. The **red rock** immediately over the sand demonstrates that the Maxton sand belongs in the **Mauch Chunk** series and not the **Pottsville.**

John Maple Well[18] No. 4 (W 38) Church District.

One mile northeast of Burton. Authority, Fisher Oil Company.

	Feet	Feet.
Pittsburg Coal	1190	
Little Dunkard Sand (I Cow Run)	1575 to	1625
Big Dunkard Sand (Mahoning)	1655 to	1690
Salt Sand	2120 to	2190
Red cave	2256 to	2318
Maxton Sand	2318	

17. Vol. 1 (A), p. 178 W. Va. Geol. Survey
18. Ibid, p. 179.

	Feet.	Feet.
First pay	2350	to 2352
Second pay	2365	to 2370
Total depth		2373

W. G. Snodgrass[19] Well No. 1 (W 39), Church District.

One mile northeast of Burton. Authority, Fisher Oil Company.

	Feet	Feet.
Pittsburg Coal	1179	
Little Dunkard Sand (1 Cow Run)	1558	to 1620
Big Dunkard Sand (Mahoning)	1640	to 1680
Salt Sand	2112	to 2165
Red cave	2225	to 2311
Maxton Sand	2311	to 2363
First pay	2335	to 2342
Second pay	2353	to 2358
Total depth		2363

Interval from top of **Pittsburg coal** to **Maxton sand** is 1132 feet.

Interval from top of Pittsburg coal to Maxton sand is 1132 feet.

About 1 mile east of Cottontown a well was drilled on the dividing ridge just across the county line in the edge of Monongalia that gives the following succession:

Jacob Liming No. 1 Well Record (W 29), Battelle District.

One mile east of Cottontown. Authority, Pure Oil Co.

	Feet	Feet.
Coal, Pittsburg	1195	to 1200
Little Dunkard sand (1 Cow Run)	1578	to 1623
Big Dunkard sand	1710	to 1755
Maxton sand	2331	to 2349
Big lime	2377	to 2434
Big Injun sand	2434	to 2674
Gordon sand	3328	to 3363
Fourth sand	3388	to 3410
Unrecorded to bottom	3410	to 3448
Interval from top of **Pittsburg coal** to **Maxton sand**		1136
Interval from top of **Pittsburg coal** to **Big Injun sand**		1239
Interval from top of **Pittsburg coal** to **Gordon sand**		2133
Interval from top of **Pittsburg coal** to **Fourth sand**		2243

A small Thirty-foot sand well was drilled in 6 or 7 years ago on the Shriver farm, one mile northeast of Glover Gap tunnel. Its record was published in Vol. I (a), pp. 176-177, of the State Survey reports, and is as follows:

19. Vol. I (a), p. 179, W. Va. Geol. Survey.

Sol. Shriver No. 1 Well Record (W 30), Church District.

Two miles southeast of Burton. Authority, Carter Oil Co.

	Feet		Feet.
Mapletown coal	912	to	917
Pittsburg Coal	1012	to	1014
Cave	1014	to	1032
Little Dunkard Sand (I Cow Run)	1332	to	1376
Dunkard Sand	1410	to	1442
Sand	1460	to	1925
Little Lime	2145	to	2160
Big Lime	2195	to	2280
Big Injun Sand (water at 2505′)	2280	to	2535
Pencil cave	2840	to	2870
Gantz Sand	2870	to	2966
"Fifty-foot" Sand	2973	to	3003
"Thirty-foot" Sand (gas, 3029′; oil 3044′)	3023	to	3055
"Stray" Sand	3070	to	3085
Gordon Sand	3105	to	3175
Fourth Sand	3185	to	3219
Bayard Sand	3377	to	3383

(Two-barrel well.) **in "Thirty-foot".**

Interval from top of **Pittsburg coal** to **Big Injun sand**	1268
Interval from top of **Pittsburg coal** to **Gantz sand**	1858
Interval from top of **Pittsburg coal** to **Thirty-foot sand**	1961
Interval from top of **Pittsburg coal** to **Gordon sand**	2093
Interval from top of **Pittsburg coal** to **Fourth sand**	2173
Interval from top of **Pittsburg coal** to **Bayard sand**	2365

This well record shows only 2 feet of **Pittsburg coal** at this point. The well must have struck a roll or fault in the bed, since logs of other wells in all directions surrounding this well report a good thickness, 6 to 8 feet of Pittsburg coal.

One mile due west of this well, the Carnegie Natural Gas Co. put down a boring on the Pogue farm (W 28) that starts flush with the outcrop of the **Hostetter coal.** Its record is as follows:

L. E. Pogue No. 1 Well Record (W 28), Church District.

One-third mile north of Glover Gap tunnel. Authority, Carnegie Natural Gas Co.

	Feet		Feet.
Pittsburg coal	939		
Big Injun sand to bottom of hole	2178	to	2293

First gas at 2190′.
Second gas at 2273′.

10" casing 153; 8¼" casing 1347; 6 5-8" casing 2141; 4" casing 2293.

Rock pressure, 650 lbs.

There are 3 or 4 other Big Injun gas wells in Church district, surrounding this tunnel on the Troy and other farms.

Along the crest and a short distance down the slopes of the Hundred anticline in Church district there occurs a great gas field. The gas is mostly from the **Big Injun sand,** but some wells are found in the **Maxton, Fifty-foot** and **Fourth sands.** The records of the following wells, fourteen in number, scattered along this arch in the rocks, give a large fund of information not only concerning the **oil and gas** horizons, but the **coal beds** as well:

W. H. Himelrick No. 1 Well Record (W 14), Church District.

On Rockcamp run, one mile and three-fourths north of Hundred. Authority, Philadelphia Company.

	Feet		Feet.
Coal, native (Waynesburg)	420	to	422
Coal, Mapletown (Sewickley)	685	to	690
Coal, Pittsburg	785	to	790
Gas sand	1645	to	1700
Little gas at 1400′ and 1520′.			
Salt sand	1760	to	1805
Maxton sand	1875	to	1965
Big lime	1975	to	2040
Big Injun sand	2040	to	2270
"Thirty-foot" sand	2760	to	2810
Red rock at 2870.			
Gordon Stray	2865	to	2885
Gordon sand	2885	to	2942
Fourth sand	2971	to	2996
Slate to bottom	2996	to	3197
Interval from top of **Pittsburg coal** to **Maxton sand**			1090
Interval from top of **Pittsburg coal** to **Big Injun sand**			1255
Interval from top of **Pittsburg coal** to **Thirty-foot sand**			1975
Interval from top of **Pittsburg coal** to **red rock**			2085
Interval from top of **Pittsburg coal** to **Gordon sand**			2100
Interval from top of **Pittsburg coal** to **Fourth sand**			2186

A little gas show in Gas sand (II Cow Run?), but not enough to pay and well was abandoned as dry.

Henry Hixenbaugh No. 1 Well Record (W 15), Church

Located on Cappo run of Church fork, one mile and a

half northeast of Hundred. Authority, Wheeling Natural Gas Company.

	Feet.		Feet.
Big water flow at 40 ft., 80 ft. and 230 ft.			
Slate, lime, and sand	423	to	426
Slate and lime	426	to	671
Mapletown coal (Sewickley)	671	to	675
Hard lime	675	to	768
Pittsburg coal	768	to	774
Slate and red cave	774	to	1150
Little Dunkard sand (I Cow Run)	1150	to	1180
Gritty lime	1180	to	1270
White cave	1270	to	1285
Gas sand	1400	to	1450
Salt sand	1500	to	1640
Salt sand	1710	to	1790
Maxton sand (small gas 1865-1885)	1850	to	1920
Big lime	1920	to	1950
Big Injun sand	1950	to	2195
Slate and shells (50-foot)	2195	to	2805
Campbells Run sand (30-foot)	2805	to	2845
Red rock	2845	to	2849
Gordon Stray sand	2849	to	2869
Slate and shells	2869	to	2918
Gordon sand	2918	to	2970
Fourth sand, small gas	2985	to	3010
Sand shells	3082	to	3085
Slate and Bastard lime to bottom	3085	to	3371
Interval from top of **Pittsburg coal** to **Maxton sand**	1082		
Interval from top of **Pittsburg coal** to **Big Injun sand**	1182		
Interval from top of **Pittsburg coal** to **Thirty-foot sand**	2037		
Interval from top of **Pittsburg coal** to **red rock**	2077		
Interval from top of **Pittsburg coal** to **Gordon sand**	2150		
Interval from top of **Pittsburg coal** to **Fourth sand**	2217		

The interval below the top of Pittsburg coal of the Big Injun sand (1182 feet) is 60 feet less than usually found in this portion of Church district, and the decrease is no doubt caused by the local thinning of the **Big lime**, since it is reported only 30 feet thick. This well is almost midway on a northeast-southwest line through two other wells; viz., Jos. Phillips No. 1 (W 9), and S. J. Elliot No. 1 (W 16) in which the same interval is 1242 and 1240 feet respectively. The record of the Elliot well (W 16) is as follows:

S. J. Elliot No. 1 Well Record (W 16), Church District.

Located 3-4 mile east of Hundred at mouth of Cappo run. (1032 A. T). Authority, Philadelphia Company.

	Feet		Feet.
Coal, Mapletown (Sewickley)	630	to	635
Coal, Pittsburg (top 297' A T.)	735	to	740
Big Dunkard sand	1285	to	1325
Maxton sand	1840	to	1915
Gas at 1875' and at 1900'.			
Big lime	1913	to	1975
Big Injun sand (gas at 2100')	1975	to	2240
"Fifty-foot" sand	2725	to	2765
"Thirty-foot" sand	2775	to	2805
Gordon Stray sand	2805	to	2820
Gordon sand	2850	to	2900
Slate to bottom	2900	to	2903
Interval from top of **Pittsburg coal** to **Maxton sand**			1105
Interval from top of **Pittsburg coal** to **Big Injun sand**			1240
Interval from top of **Pittsburg coal** to **Fifty-foot sand**			1990
Interval from top of **Pittsburg coal** to **Thirty-foot sand**			2040
Interval from top of **Pittsburg coal** to **Gordon Stray sand**			2070
Interval from top of **Pittsburg coal** to **Gordon sand**			2115

Mary E. Hunt No. 1 Well Record (W 40), Church District.

Located at mouth of Rockcamp run, ¾ mile N. W. of Hundred. Authority, Carnegie Natural Gas Co.

	Feet		Feet.
Sewickley coal	576		
Pittsburg coal	691		
Gas sand (gas)	1440	to	1500
Big Injun sand	1926	to	2180
Gantz sand	2605	to	2630
Thirty-foot sand (gas at bottom)	2720	to	2735
Gordon Stray sand	2760	to	2790
Gordon sand	2810	to	2835
Fourth sand	2880	to	2895
Fifth sand	2945		
Unrecorded	2945	to	2971

Small gas well in the **Thirty-foot sand**, the latter coming 2029 feet below the **Pittsburg coal**.

The first well to be drilled in this Hundred gas field was the old T. B. Hamilton No. 1 well (W 19), located at the mouth of Church fork within the present corporation limits of the town of Hundred. This well was drilled 23 years ago by Gibson and Giles, and furnished sufficient gas from the Pittsburg coal to supply the town with fuel for several years.

Geo. F. Throckmorton No. 1 Well Record (W 22), Church

One mile S. E. of Hundred, near mouth of Rush Run. Authority, Philadelphia Company.

	Feet		Feet.
Bluff sand	362	to	392
Coal, Waynesburg	392	to	395
Coal, Mapletown (Sewickley)	626	to	635
Coal, Pittsburg	727	to	737
Little Dunkard sand (I Cow Run)	1124	to	1160
Big Dunkard sand (Mahoning)	1180	to	1250
Sand	1265	to	1298
Gas sand (Lower Freeport)	1346	to	1421
Salt sand No. 1	1500	to	1588
Salt sand No. 2	1660	to	1750
Maxton sand (gas at 1839′)	1813	to	1897
Big Lime	1900	to	1950
Big Injun sand (gas)	1950	to	2200
Squaw sand	2270	to	2330
"Fifty-foot" sand? **(Berea Grit)**	2500	to	2540
"Thirty-foot" sand? **(Fifty-foot)**	2670	to	2720
Campbells run sand **(Thirty-foot)**	2730	to	2754
Gordon Stray sand	2763	to	2808
Gordon sand (little gas at 2859-2864)	2829	to	2884
Fourth sand (gas at 2930′)	2918	to	2945
Fifth sand	2968	to	2998
Total depth			3128
Interval from top of **Pittsburg coal** to **Maxton sand**			1086
Interval from top of **Pittsburg coal** to **Big Injun sand**			1223
Interval from top of **Pittsburg coal** to **Berea Grit sand**			1773
Interval from top of **Pittsburg coal** to **Thirty-foot sand**			2003
Interval from top of **Pittsburg coal** to **Gordon sand**			2102
Interval from top of **Pittsburg coal** to **Fourth sand**			2191
Interval from top of **Pittsburg coal** to **Fifth sand**			2241

Gas was encountered at 4 horizons; viz., **Maxton, Big Injun, Gordon,** and **Fourth** sands.

W. C. Whitlatch No. 1 Well Record (W 26), Church District.

Located on north side B. & O. R. R., ⅓ mile N. E. of Burton Station. Authority, Carnegie Natural Gas Co.

	Feet.		Feet.
Pittsburg coal	843	to	850
Big Injun sand (small gas at 2105′)	2065	to	2309
Gantz sand? **(Fifty-foot)**	2767	to	2795
Fifty-foot sand? **(Thirty-foot)**	2826	to	2871
Gordon Stray sand	2886	to	. . .
Gordon sand	2925	to	2993
Fourth sand	3015	to	3054
Fifth sand	3115	to	3130
Bayard sand (little gas on top)	3215	to	3218
Unrecorded to bottom (steel line)	3218	to	3279
Interval from top of **Pittsburg coal** to **Big Injun sand**			1222
Interval from top of **Pittsburg coal** to **"Fifty-foot" sand**			1924
Interval from top of **Pittsburg coal** to **"Thirty-foot" sand**			1983
Interval from top of **Pittsburg coal** to **Gordon Stray sand**			2043
Interval from top of **Pittsburg coal** to **Gordon sand**			2082

	Feet.
Interval from top of **Pittsburg coal** to **Fourth sand**	2172
Interval from top of **Pittsburg coal** to **Fifth sand**	2272
Interval from top of **Pittsburg coal** to **Bayard sand**	2372

Gas was encountered in both the **Big Injun** and **Bayard** sands. This is the only well to the writer's knowledge that produces either gas or oil from the latter horizon in the Marshall-Wetzel-Tyler area.

W. L. Cunningham No. 1 Well Record (W 34), Church

At the head of Rush run, 1 mile and 4-10ths S. of Burton. Authority, Philadelphia Company.

	Feet.		Feet.
Coal, Mapletown (Sewickley)	781	to	787
Coal Pittsburg	884	to	890
Big Dunkard sand	1385	to	1425
Salt sand	1800	to	1890
Gas at 1825′ (exhausted).			
Maxton sand	2010	to	2083
Big lime (**oil show** at 2087′)	2087	to	2168
Big Injun sand (gas at 2175′)	2168	to	2385
Gantz sand	2838	to	2862
Fifty-foot sand	2866	to	2905
Thirty-foot sand	2910	to	2959
Gordon Stray sand	2965	to	2985
Sand break (Gordon)	2980	to	....
Fourth sand (gas at 3084′)	3073	to	3105
Slate to bottom	3105	to	3493

Gas was found here in the **Salt**, **Big Injun**, and **Fourth** sands. The **oil showing** at the top of the **Big lime (Greenbrier Limestone)** is unusual in this portion of West Virginia. The **Maxton sand**, 73 feet in thickness, extends to within 4 feet of the Big Lime and it may be the oil horizon is in the bottom portion of the Maxton sand.

Geo. W. Thomas No. 1 Well Record (W 44), Church Dist.

Located on Ash camp run of Long Drain, 2.2 miles due S. of Hundred. Authority, Wheeling Natural Gas Co.

	Top. Feet.	Bottom Feet.
Native coal, Washington	335	
Mapletown coal (Sewickley)	735	
Pittsburg coal	835	
Little Dunkard sand (**I Cow Run**)	1185	
Big Dunkard sand	1315	
Gas sand (Lower Freeport)	1400	
First Salt sand	1550	
Second Salt sand	1750	

	Top. Feet.	Bottom Feet.
Maxton sand	1905	
Little lime	1995	
Pencil cave	2005	
Big lime	2010	
Big Injun sand (gas at 2130 and 2172 ft.)	2095	to 2330
Gantz sand	2740	
Fifty-foot sand	2825	
Thirty-foot sand	2855	to 2880
Gordon Stray sand	2890	to 2920
Gordon sand	2962	to 2999
Fourth sand	3009	
Fifth sand shells	3127	
Slate and shells to bottom	3127	to 3440

Good gas well in the **Big Injun sand.**

Wm. Divine No. 1 Well Record (W 43), Church District.

Located one mile and 8-10ths due south of Hundred, and ½ mile northeast of the G. W. Thomas No. 1 well (W 44) above. Authority, Wheeling Natural Gas Co.

	Feet.	Feet.
Lime and slate	14 to	720
Waynesburg coal	720 to	724
Sand and lime	724 to	957
Mapletown coal (Sewickley)	957 to	962
Lime	962 to	1055
Pittsburg coal	1055 to	1062
Slate and red rock	1062 to	1405
Little Dunkard sand **(I Cow Run)** Saltsburg	1405 to	1453
Big Dunkard sand	1510 to	1590
Gas sand **(II Cow Run?)**	1672 to	1697
Salt sand	1840 to	1940
Maxton sand, gas 2200-2228	2168 to	2243
Big lime	2246 to	2325
Big Injun sand, gas	2325 to	2419
Top of **Pittsburg coal** to **I Cow Run sand**		350
Top of **Pittsburg coal** to **Maxton sand**		1113
Top of **Pittsburg coal** to **Big Injun sand**		1270

This well is close the axis of the Hundred anticline and gas was found in both the Maxton and Big Injun sands. The **thickness** of the **Monongahela series** is shown to be 342 feet in this portion of Church district.

Helena Taylor No. 1 Well Record (W 45), Church District.

Located one mile and a half due north of Earnshaw near head of Moses run of Long Drain. Authority, Philadelphia Company.

	Feet.		Feet.
Pittsburg coal	840	to	848
Big Dunkard sand	1327	to	1385
Gas sand (II Cow Run), (water at 1650′; gas at 1650′)	1630	to	1700
Maxton sand	1960	to	2028
Big lime	2030	to	2075
Big Injun sand	2075	to	2313
Fifty-foot sand	2830	to	2865
Thirty-foot sand	2880	to	2915
Gordon Stray sand	2940	to	2952
Gordon sand	2955	to	2990
Fourth sand	3022	to	3047
Fifth sand	3105	to	3110

Well dry in all sands except light show of gas in **II Cow Run** and hole plugged with 3 sets of plugs.

	Feet.
Top of **Pittsburg coal** to **II Cow Run sand**	790
Top of **Pittsburg coal** to **Maxton sand**	1120
Top of **Pittsburg coal** to **Big Injun sand**	1235
Top of **Pttsburg coal** to **Gordon sand**	2115
Top of **Pittsburg coal** to **Fourth sand**	2182
Top of **Pittsburg coal** to **Fifth sand**	2265

In the extreme southwest corner of Church district there occurs a small **Fourth sand** (?) oil pool. The following record is from a well in this pool:

Feet.

Wm. Teagarden, No. 2 Well Record (W 48), Church District

Located on branch of Long Drain, 2¼ miles W. of Earnshaw. Authority, Philadelphia Company.

	Feet.		Feet.
Pittsburg coal	870	to	878
Red rock at	1165		
Limestone at	1275		
Little Dunkard sand	1280	to	1330
Big Dunkard sand	1360	to	1400
Salt sand	1855	to	2050
Big lime	2055	to	2155
Big Injun sand	2155	to	2375
Fifty-foot sand	2700	to	2750
Gordon Stray sand	2915	to	2945
Gordon sand	2950	to	2965
Show of gas at 2955′.			
Fourth sand to bottom	3005	to	3029
Break of 15 ft. in Fourth sand.			
Fourth sand oil	3025	to	3029
Top of **Pittsburg coal** to **Big Injun sand**			1285
Top of **Pittsburg coal** to **Gordon sand**			2080
Top of **Pittsburg coal** to **Fourth sand**			2135

It may be that the oil horizon here identified by the driller as the **Fourth** is the **Gordon** sand, since the interval from the **Pittsburg coal** to the Big Injun sand in this well is 50 feet greater than in the Helena Taylor (W 45) above, located 3 miles to the northeast.

Wm. Teagarden No. 1 Well Record (W 47), Church District.

Located 2 miles W. of Earnshaw. Authority, Philadelphia Company.

	Top. Feet.	Thickness. Feet.
Coal, Pittsburg	845	8
Salt sand	1580	330
Big Injun sand	2105	220
Gordon Stray sand	2877	26
Gordon sand	2917	23
Fourth sand (gas in?)	2967	45

In 6 1-4″ casing:

First minute pressure, 500 lbs.
Second minute pressure, 575 lbs.

Hugh Cosgray No. 1 Well Record (W 51), Church District.

Located 1 mile N. E. of Anthem P. O. Authority, Wheeling Natural Gas Co.

	Feet.		Feet.
Coal, Uniontown	880	to	884
Mapletown coal (Sewickley)	1034	to	1040
Pittsburg coal	1135	to	1145
Little Dunkard sand (I Cow Run)	1482	to	1494
Big Dunkard sand	1615	to	1655
Gas sand (II Cow Run)	1900	to	1935
Salt sand	2035	to	2170
Maxton sand	2206	to	2228
Little lime	2294	to	2306
Big lime	2310	to	2387
Big Injun sand (small amount gas)	2387	to	2627
Red rock	3097		
Gordon Stray sand	3195	to	3230
Gordon sand	3233	to	3250
Fourth sand	3297	to	3317
No Fifth sand.			
Sixth sand. Bayard sand, very little sand	3547		
Unrecorded to bottom	3547	to	3597
Top of **Pittsburg coal to Big Injun sand**	1252		
Top of **Pittsburg coal to red rock**	1962		
Top of **Pittsburg coal to Gordon sand**	2098		
Top of **Pittsburg coal to Fourth sand**	2162		
Top of **Pittsburg coal to Bayard sand**	2412		

This well is located nearly on the axis of the Littleton anticline, and is a small gasser in the Big Injun.

R. H. Haines No. 1 Well Record (W 41), Church District.

Head of Stottlemire run, 1 mile S. W. of Hundred. Authority, Philadelphia Company.

	Feet.		Feet.
Coal, Mapletown (Sewickley)	755	to	758
Coal, Pitsburg	858	to	865
Little Dunkard sand	1340	to	1390
Gas sand (gas near 1565')	1560	to	1640
Salt sand	1765	to	1880
Big lime	1960	to	2120
Big Injun sand	2120	to	2370
Fifty-foot sand	2630	to	2700
Gordon Stray sand	2910	to	2925
Gordon sand	2938	to	2963
Fourth sand	3008	to	3031
Fifth sand		to	3050
Slate to bottom	3050	to	3213

In the northwest corner of Church district there occurs a group of 25 to 30 oil wells on the east slope of the Littleton anticline. The writer did not obtain the logs of any wells from this area, but the pool is an extension of the New Freeport field of Greene county, Pa., in which Stone & Clapp[20] identify the main oil horizon as the **Nineveh sand** and not the **Gordon** as generally recognized by the drillers throughout that field. The horizon of the **Nineveh sand** as recognized by Stone & Clapp is shown by the record of the Dennis Meighen No. 1 well (W 52), published by them in their Bulletin No. 304, page 79, of the U. S. G.Survey reports under the name "D. R. Meigham No. 1 (136)." This well is located on the head of Wolf run of Fish creek, just across the W. Va.-Penna. State line in the edge of Springhill township, Greene county, Pa., one mile and a third due west of the point where the above oil pool enters Church district from Pennsylvania, and 2 miles N. 20°-30° E. of Littleton. The record of the Meighen well as published is as follows:

20. Bulletin No. 304, pp. 37-38, 44-45, U. S. G. Survey, and No. 285, 1906, pp. 362-366, U. S. G. Survey—F. G. Clapp.

Dennis Meighen No. 1 Well Record (W 52), Springhill

	Thickness Feet.	Depth Feet.
Coal, Pittsburg	6	1086
Sand, Big Dunkard	110	1680
Sand, Gas	60	1890
Lime (water at 1960 feet; **gas at 2010 ft.**)	25	1970
Lime, Big	75	2335
Sand, Big Injun	165	2590
Sand, Fifty-foot	15	3090
Sand, Nineveh	11	3128
Sand and shells	7	3140
Sand and shells	7	3175
Sand and shells	9	3195
Sand with slate	5	3243
Shells	5	3295
Total depth		3424
Top of **Pittsburg coal** to **Big Injun sand**		1245
Top of **Pittsburg coal** to **Nineveh sand**		2037

The gas reported at a depth of 2010 feet, coming only 930 feet below the top of the Pittsburg coal, undoubtedly occurs in the **Salt sand** and not the **"Salvation" (Maxton)** as published in the bulletin referred to above, since the top of the Salvation (Maxton) sand in this region ranges from 1075 to 1125 feet below the top of the Pittsburg coal. The same interval in the W. H. Himelrick No. 1 well (W 14), page 426 located on Rockcamp run ,3 miles S. 60°-70° E. of the Meighen well, is 1090 feet.

CLAY DISTRICT.

Clay district lies on the west of Church district and adjoins the southwest corner of the State of Pennsylvania on the south. The Littleton anticline passes entirely across its eastern margin in a S. 25°-30° W. course, throwing by far the greater portion of its area on the western flank of this arch in the rocks. Along this anticline and a short distance down its slopes are found several fine gas wells. The records of the following wells scattered through this field from north to south will now be given:

Harvey Villiers No. 1 Well Record (W 62), Clay District.

One mile east of Littleton station at mouth of Browns run. Authority, Wheeling Natural Gas Co. (Drilled in 1905)

	Feet.		Feet.
Pittsburg coal (gas in coal)	660	to	668
Big Dunkard sand	1115	to	1205
Gas sand (Lower Freeport)	1360	to	1420
Salt sand (gas at 1470 feet)	1450	to	1530
Second Salt sand	1560	to	1640
Little lime	1820	to	1840
Big lime	1840	to	1900
Big Injun sand	1900	to	2140
Stray sand	2734	to	2754
Gordon sand	2758	to	2781
Fourth sand (gas at 2833 feet)	2830	to	2847
Top of **Pittsburg coal** to **Big Injun sand**			1240
Top of **Pittsburg coal** to **Stray sand**			2074
Top of **Pittsburg coal** to **Gordon sand**			2098
Top of **Pittsburg coal** to **Fourth sand**			2170

The Villiers well (W 62) is located 1.7 miles S. 5°-10° E. from the Meighen well (W 52) above. It thus appears that the sand in the latter well. coming 2037 feet below the top of the Pittsburg coal, identified by Stone & Clapp as the **Nineveh,** correlates with the **Thirty-foot** sand as claimed by them. However, the northward thinning of the measures that takes place in this region might easily reduce the **Gordon sand** interval (2098 feet) of the Villiers well (W 62) to to that given (2098 feet) for the **Nineveh sand** in the Meighen well (W 52) above.

J. A. Conley No. 1 Well Record (W 53), Clay District.

Located ½ mile east of Littleton Station on east side of Wolf run. Authority, Philadelphia Company.

	Feet.		Feet.
Native coal (Waynesburg "A")	507	to	510
Mapletown coal (Sewickley)	770	to	774
Pittsburg coal	885	to	893
Big Dunkard sand	1375	to	1405
Salt sand	1695	to	1794
Big lime	2078	to	2145
Big Injun sand	2145	to	2375
Break	2235	to	2238
Gordon sand	2962	to	2993
Fourth sand (gas at 3034 feet)	3030	to	3047
Fifth sand	3095	to	3100
Top of **Pittsburg coal** to **Big Injun sand**			1260
Top of **Pittsburg coal** to **Gordon sand**			2077
Top of **Pittsburg coal** to **Fourth sand**			2145
Top of **Pittsburg coal** to **Fifth sand**			2210

This well starts on top of the great **Fish Creek** sandstone (35 to 40 feet thick) of the Dunkard series, thus making the

interval of the **Fish Creek coal** at the base of the sandstone down to the Pittsburg coal 845 to 850 feet.

The following record is taken from Vol. I (a), pp. 181-182, W. Va. Geol. Survey.

Jas. O'Day No. 1 Well Record (W 57), Clay District.

Just south of Littleton and B. & O. R. R. Authority, Hope Natural Gas Company.

	Feet.		Feet.
Pittsburg coal	785	to	791
Dunkard sand	1273	to	1333
Pencil cave	1960	to	1970
Big Injun sand	2061	to	2280
"Thirty-foot" (Berea?)	2590	to	2630
"Fifty-foot" sand	2737	to	2760
Gordon sand	2887	to	2903
Fourth sand (gas from 2958 to 2963')	2958	to	2963
Total depth	2972		

The following is the record of a well located on the eastern flank or slope of the Littleton anticline, ¾ mile southwest of the B. & O. R. R. This well (W 60) is nearly on the same structural level and on the same side of the arch of the rocks as the Nineveh sand oil pool on the head of Rockcamp run in the northwest corner of Church district. The well filled up 1,000 feet with oil from a sand that the driller has identified as the Gordon stray, coming 2030 feet below the top of the Pittsburg coal. It seems quite probable that this is at the same horizon as the oil found in the Rockcamp run pool, and if so, the **Nineveh sand** would then correlate with the **Gordon Stray sand:**

Peter Kiger No. 1 Well Record (W 60), Clay District.

Located 2.1 miles southeast of Littleton Station, on Stottlemire run. Authority. Carnegie Natural Gas Co.

	Feet.		Feet.
Pittsburg coal	835	to	843
Big Injun sand	2085	to	2315
Gas at 2097 and 2160 feet.			
Fifty-foot sand	2790	to	2835
Gordon Stray sand	2865	to	2885
Oil show, filled up 1000 feet	2880		
Gordon sand	2908	to	2932
Fourth sand	2955	to	2983
Fifth sand to bottom	3020	to	3035

	Feet.
Top of **Pittsburg coal to Big Injun sand**	1250
Top of **Pittsburg coal to Fifty-foot sand**	1955
Top of **Pittsburg coal to Gordon Stray sand**	2030
Top of **Pittsburg coal to Gordon sand**	2073
Top of **Pittsburg coal to Fourth sand**	2120
Top of **Pittsburg coal to Fifth sand**	2185

From the mouth of Long Drain southwest to Sugar run and thence up the latter to the Clay-Center district line there occurs an oil pool of 40 to 50 wells on the western flank of the Littleton anticline. The oil is found mostly in the **Fourth sand.** The following well records, 4 in number, are scattered southwest from Littleton along this belt of wells, W 56, W 64, and W 65 from Vol I (a), pp. 182-183, of State Survey reports:

Geo. N. Gillingham No. 1 Well Record (W 56), Clay District.

Located 1 mile south of Littleton. Authority, South Penn Oil Co.

(Steel line.)	Feet	Feet.
Mapletown coal (Sewickley)	1090	
Pittsburg Coal	1190	
Little Dunkard Sand	1575	to 1595
Big Dunkard Sand	1685	to 1735
"Gas" Sand	2000	to 2080
Salt Sand	2140	to 2270
Little Lime	2390	
Big Lime	2393	to 2468
Big Injun Sand	2480	to 2710
"Fifty-foot" Sand	3050	
Gordon Sand	3286	to 3332
Fourth Sand (oil, 3367')	3362	
Total depth	3377	
Top of **Pittsburg coal to Big Injun sand**		1290
Top of **Pittsburg coal to Gordon sand**		2096
Top of **Pittsburg coal to Fourth sand**		2172

S. Newman No. 3 Well Record (W 64), Clay District.

Located on east side of Sugar run, 1 mile and a half south of Littleton. Authority, South Penn Oil Company.

	Feet.	Feet.
Mapletown Coal (Sewickley)	794	to ....
Pittsburg Coal	894	to ....
Little Dunkard Sand	1261	to 1281
Dunkard Sand	1371	to 1425
"Gas" Sand	1635	to 1645
Salt Sand	1672	to 1770

Maxton Sand	1878	to	1925
Little Lime	2060	to	....
Big Lime	2082	to	2165
Big Injun Sand	2165	to	2390
Gordon Sand (oil, 3017′)	3007	to	3030
Fourth Sand (oil, 3072′)	3068		
Total depth	3083½		

Both Gordon and Fourth sand oil in this well.

Wm. Newman No. 3 Well Record (W 65), Clay District.

Located on west side of Sugar run, opposite S. Newman No. 3 (W 64). Authority, South Penn Oil Company.

(Steel line.)	Feet		Feet.
Mapletown Coal (Sewickley)	832	to	....
Pittsburg Coal	932	to	....
Little Dunkard Sand **(I Cow Run)**	1260	to	1285
Big Dunkard Sand	1400	to	1470
Gas Sand	1625	to	1650
Maxton Sand	2005	to	2050
Little Lime	2075	to	2130
Big Lime	2145	to	2206
Big Injun Sand (gas, 2296)	2206	to	2440
"Stray" Sand	3015	to	3026
Gordon Sand	3031	to	3065
Fourth Sand (oil, 3105′)	3102		
Total depth	3118		
(Ten-barrel well).			
Top of **Pittsburg coal** to **Maxton sand**	1073		
Top of **Pittsburg coal** to **Big Injun sand**	1274		
Top of **Pittsburg coal** to **Gordon sand**	2099		
Top of **Pittsburg coal** to **Fourth sand**	2170		

This well is a gasser in the Big Injun sand as well as an oil producer from the Fourth.

Eliz. Anderson No. 1 Well Record (W 67), Clay District.

Located on Sugar run, 2½ miles S. W. of Littleton. Authority, Carnegie Natural Gas Co.

	Feet.
Mapletown coal (Sewickley)	712
Pittsburg coal	812
Big Injun sand	2050
First gas at 2058-2070 feet.	
Second gas at 2130 feet.	
Total depth	2150

At ½	minute	pressure	= 80	lbs.
" 1	"	"	= 135	"
" 2	"	"	= 240	"
" 3	"	"	= 320	"
" 4	"	"	= 390	"
" 5	"	"	= 648	"

This well is a northeast extension of the Big Injun sand gas field on the head of Knob fork.

A test well was drilled on the A. J. Bissett land at the mouth of Boardtree run, 1 mile northwest of Littleton down to the Gordon sand. A small showing of gas was found but the well was abandoned as a dry hole. There does not appear to have been any drilling done in the western half of Clay district with the exception of the Bissett well referred to above.

CENTER DISTRICT.

Center district, Wetzel county, lies directly west from Clay and Church districts, and is traversed in a northeast-southwest direction by two structural folds; viz., the Littleton anticline, passing through the southeast corner, and the deep Nineveh syncline, through the western portion. The Steels run oil field lies entirely within the boundaries of this district extending directly from the axis of the Nineveh trough eastward up the western slope of the Littleton anticline. The great gas field in the vicinity of Uniontown lies farther east near the crest of the same arch in the rocks. The record of the following wells scattered through this gas field give valuable data concerning both the oil and gas horizons and the coal beds:

W. J. Cross No. 1 Well Record (W 85), Center District.

Located ¾ mile N. E. of Uniontown. Authority Carter Oil Co.

	Top Feet.	Thickness. Feet.
Coal, Mapletown (Sewckley)	892	5
Coal, Pittsburg	992	6
I Cow Run sand	1360	15
Cow Run sand? (Dunkard)	1460	50
Water at 1761 feet.		
Salt sand	1962	80
Maxton sand	2100	80
Cave, (Pencil)	2200	6
Big lime	2206	63
Big Injun sand	2269	196
Fifty-foot sand	2694	50
Gordon Stray sand	3044	34
Gas at 2065 feet.		
Gordon sand	3078	12

	Feet.
Oil at 3080 feet.	
Top of **Pittsburg coal** to **I Cow Run sand**	368
Top of **Pittsburg coal** to **Dunkard sand**	468
Top of **Pittsburg coal** to **Salt sand**	970
Top of **Pittsburg coal** to **Maxton sand**	1108
Top of **Pittsburg coal** to **Big Injun sand**	1277
Top of **Pittsburg coal** to **Gordon Stray sand**	2052
Top of **Pittsburg coal** to **Gordon sand**	2086

David Sole No. 2 Well Record (W 87), Center District

Located 8-10 mile due east of Uniontown. Authority, Carter Oil Co.

	Top Feet.	Thickness. Feet.
Coal, Pittsburg	1189	6
Big Injun sand	2460	195
Gordon Stray sand	3255	27
Gordon sand	3263	
Gas 3265'; oil 3277'.		
Unrecorded to bottom	3277 to	3290

The abbreviated records of several other wells in this region are found in the table of Wetzel county wells on page 404. Lying immediately to the west of the Uniontown gas field there occurs a belt of **Gordon sand** oil wells on the western slope of the Littleton anticline. The abbreviated records of wells W 81, W 84, W 97, W 98, and W 100, scattered southwestward along this pool across the heads of Camp and Bear runs of Knob fork, Miller fork of Rocky run, and Little Fishing creek to the Center-Grant district line, are found in the Wetzel county table of wells on page 404.

The following is the record of a dry hole drilled on the summit of a high knob, located one mile and a quarter southwest of Dean P. O.:

S. C. Miller No. 1 Well Record (W 99), Center District.

Located 2.7 miles west of Uniontown. Authority, South Penn Oil Co.

	Feet.	Feet.
Coal, Waynesburg "A"	925 to	929
Coal, Pittsburg	1400 to	1407
Dunkard sand	1900 to	1950
Pencil cave	2550 to	2560
Big lime	2560 to	2620
Big Injun sand	2620 to	2890
Gordon Stray sand	3448 to	3470
Gordon sand	3470 to	3480
Dry hole and abandoned.		

The following is the record of another well drilled near the summit of a high knob in this region, published in Vol. I (a), page 205, W. Va. Geol. Survey:

J. H. Rush No. 3 Well Record (W 101), Center District.

Located on Center-Grant district line, 2.3 miles southeast of Wileyville. Authority, Kanawha Oil Co.

	Feet.
Pittsburg coal	1410
Big Injun	2650
Stray Sand	3415
Gordon Sand	3445
Total depth	3460

The **Steel run oil field** occupies the southwest corner of Center district and consists of 150 to 200 oil wells, mostly in the **Gordon Stray** sand on Hartley, Steel, and Honey runs of Little Fishing creek, and across on the head of Morris run of Miller fork of Rocky run. The records of the following wells, 5 in number, are of interest:

T. J. Showalter No. 1 Well Record (W 104), Center District.

Located 1 mile west of Dean P. O., on Morris run. Authority, South Penn Oil Co.

	Feet.		Feet.
Coal, Native (Waynesburg)	835	to	840
Coal, Pittsburg	1160	to	1168
Big lime	2310	to	2395
Big Injun sand	2395	to	2620
Gordon Stray sand	3185	to	....
Gas at 3190 feet.			
Oil at 3208 feet.			
Total depth			3225
722 bbls. first 24 hours.			
Top of **Pittsburg coal** to **Big Injun sand**			1235
Top of **Pittsburg coal** to **Gordon Stray**			2025
Thickness of the **Monongahela series**			333

Jas. Morris No. 1 Well Record (W 106), Center District.

Located on Steels run, ⅓ mile N. of Dulaney P. O. Authority, Kanawha Oil Co.

	Feet
13" casing	59
10" casing	1208
8" casing	1428
6 ¾" casing	2058

	Depth. Feet.	Thickness Feet
Coal, Pittsburg	880	
Big Lime	2030	66
Big Injun sand	2096	249
Gordon Stray sand	2914	
Oil at 2914-2925 feet.		
Total depth	2934	

The two following records are taken from pp. 203 and 202 respectively of Vol. I (a) of the W. Va. Geol. Survey reports:

J. A. Lemasters No. 1 Well Record (W 107), Center District.

Located on Steels run, 2.1 miles N. E. of Wileyville. Authority, South Penn Oil Co.

	Feet.	Feet
"Native" Coal (Waynesburg)	791 to	795
Pittsburg Coal	1100 to	1105
Dunkard Sand	1580 to	1660
Salt Sand	1915 to	1955
Maxton Sand	2135 to	2145
Pencil cave	2243 to	2253
Big Lime	2253 to	2310
Big Injun Sand	2310 to	2535
"Stray" Sand (gas and oil,, 3134′)	3132 to	3157
(Fifteen-barrel well.)		

Sidell-Moore No. 1 Well Record (W 110), Center District.

Located 2 miles east of Wileyville on ridge between Steel and Honey runs. Authority, South Penn Oil Co.

	Feet.	Feet
Pittsburg Coal	1280 to	1287
Dunkard Sand	1760 to	1790
Salt Sand	2030 to	2230
Pencil cave	2430 to	2435
Big Lime	2435 to	2495
Big Injun Sand	2495 to	2730
"Stray" Sand (oil, 3340′)	3321 to	3342
Gordon Sand (oil, 3345′)	3343 to	3358
(Twelve-barrel well.)		
Top of **Pittsburg coal** to **Big Injun sand**		1215
Top of **Pittsburg coal** to **Gordon Stray sand**		2041
Top of **Pittsburg coal** to **Gordon sand**		2063

In this well (W 110), oil was encountered in both the Gordon Stray and Gordon sands.

In this field the log of the Geo. Adams No. 1 well (W

108), given on page 106, is of special interest in being the deepest well yet reported in the Appalachian field to the Pittsburg coal bed.

The following records, 4 in number, scattered over the northern portion of Center district are of special interest:

Frank Wade No. 1 Well Record (W 68), Center District.

Located ½ mile S. W. of mouth of Knob fork of Fish creek. Authority, South Penn Oil Co.

	Feet.	Feet
Coal, Mapletown (Sewickley)	735 to	738
Coal, Pittsburg	840 to	845
Dunkard sand	1325 to	1375
Gas sand (H. Cow Run)	1600 to	1625
Salt sand (water at 1830')	1700 to	1860
Pencil cave	1995 to	2000
Big Lime	2000 to	2054
Big Injun sand	2054 to	2300
Litle gas at 2134 feet.		
Little gas at 2183 feet.		
Fifty-foot sand	2840 to	2860
Gordon Stray sand	2880 to	2905
Oil at 2895 feet.		
Total depth	2998	
Abandoned, not a paying well		
Top of **Pittsburg coal** to **Big Injun sand**		1214
Top of **Pittsburg coal** to **Gordon Stray sand**		2040

Alfred Yoho No. 1 Well Record (W 69), Center District.

Two and one-half miles northwest of Silver Hill, in extreme N. W. corner of Center district. Authority, Philadelphia Company.

	Feet.	Feet
Coal Pittsburg	930 to	937
Big Dunkard sand	1415 to	1525
Salt sand (water at 1760 ft.)	1735 to	1840
Maxton sand	2020 to	2070
Big Lime	2130 to	2185
Big Injun sand	2185 to	2343
Little show of gas	2916 to	3090
Slate to bottom	3090 to	3223

Rufus Long No. 1 Well Record (W 71), Center District.

Located at mouth of Mudlick run, of Carney fork of Rocky run. Authority, Kanawha Oil Co.

	Top. Feet.	Bottom Feet
Pittsburg coal?	1045 to	....
Big Injun sand	2063 to	....

	Top. Feet.	Bottom Feet.
First gas	2069 to	....
First oil	2072 to	2081
Gordon sand	2895 to	2915
Oil pay		2900
Total depth		2926
10″ casing		260
8¼″ casing		1200
6⅞″ casing		1980
5 3-16″ casing		2021

This well produces oil from both the **Big Injun** and **Gordon** sands. The coal identified by the driller as the Pittsburg bed, coming only 1018 feet above the Big Injun sand, cannot possibly represent the Pittsburg coal, since the record of the Ira Jolliffe No. 1 well (W 70), located only 6-10ths mile due west gives the same interval at 1205 feet.

Near the head of Carney fork are a few scattered wells near the axis of the Nineveh syncline. The record of a well near its head is as follows:

Marion Gorby No. 1 Well Record (W 74), Center District.

Located 1 mile and ¾ due south of Silver Hill. Authority, South Penn Oil Co.

	Feet.	Feet
Coal, Mapletown (Sewickley)	1025 to	1030
Coal, Pittsburg	1131 to	1137
Dunkard sand	1660 to	1710
Coal (Lower Freeport)	1690 to	1696
Gas sand	1860 to	1910
Salt sand	2125 to	2175
Big lime	2257 to	2335
Big Injun sand (gas at 2362′ and 2426′)	2336 to	2587
Gordon Stray sand (oil)	3174 to	3195
Top of **Pittsburg** coal to **Coal, Lower Freeport**		559
Top of **Pittsburg** coal to **Big Injun sand**		1205
Top of **Pittsburg coal to Gordon Stray sand**		2043

GRANT DISTRICT.

Grant district lies directly south of Church and Center districts, and is traversed by five prominent structural folds; viz., Littleton anticline, Burchfield syncline, Hundred anticline, Arches Fork anticline, and Robinson syncline, all of which have played a prominent part in accumulating the rich oil and gas fields of Grant district. In the northwest

corner of the latter area there is a large Gordon sand oil pool on the western slope of the Littleton anticline and around the nose of the Big Moses anticline. This pool consists of 150 to 200 wells, located on Barker, Betsy, Maud, and Fourmile runs of Little Fishing creek and is known as the Pine Grove field.

The records of the 2 following wells published in Vol. I (a), pp. 193 and 194-5, respectively, of the State Survey reports, give the horizon in which the oil is found:

Franklin Blake No. 1 Well Record (W 117), Grant District.

Located on ridge head of Fourmile run, 2.6 miles N. E. of Keough P. O. Authority, South Penn Oil Co.

	Feet.		Feet
Pittsburg Coal	1312	to	1320
Dunkard Sand	1770	to	1850
"Gas" Sand (Lower Freeport)	1920	to	2014
Salt Sand	2054	to	2300
Pencil cave	2478	to	2485
Big Lime	2485	to	2550
Big Injun sand	2550	to	2770
Sand	2890	to	2920
"Fifty-foot" Sand	3120	to	3135
Gordon "Stray"	3325	to	3366
"Break" (slate)	3366	to	3378
Gordon Sand (oil, 3378')	3378	to	3384
Total depth	3392		

Zue Lantz No. 2 Well Record (W 126), Grant District.

Located 1.3 mile N. E. of Pine Grove on south bank of North fork, ¼ mile above mouth of Barker run. Authority, South Penn Oil Co.

	Feet.		Feet.
Pittsburg Coal	501	to	567
Dunkard Sand	990	to	1050
Salt Sand	1410	to	1465
Maxton Sand	1590	to	1635
Little Lime	1650	to	1665
Pencil cave	1665	to	1675
Big Lime	1675	to	1730
Big Injun Sand	1730	to	1985
"Fifty-foot" Sand	2310	to	2525
Red rock	2395	to	2450
Gordon "Stray"	2544		
Gordon Sand (oil, 2578')	2574½	to	2626
Top of **Pittsburg coal** to **Salt sand**			903
Top of **Pittsburg coal** to **Maxton sand**			1089
Top of **Pittsburg coal** to **Big Injun sand**			1229

	Feet.
Top of **Pittsburg coal** to **red rock**	1894
Top of **Pittsburg coal** to **Gordon Stray sand**	2043
Top of **Pittsburg coal** to **Gordon sand**	2073½

This last record and the intervals given for the various horizons demonstrates conclusively that the oil horizon in this field is the **Gordon** sand and not the **Gordon Stray** as in the **Steel run field** northward on the waters of Little Fishing. The abbreviated records of wells W 119, W 121, W 123, W 124 and W 125, scattered throughout this field, are found listed in the Wetzel county table of wells on page 404.

Southeast of the Pine Grove oil field there occurs a great gas field in Grant district along the crest of the Littleton anticline and a short distance down on both its flanks. This gas pool enters Grant from Center district at the head of Big run of North fork and extends S. 40°-45°W. via Lowman P. O. (Kingtown), Upper and Lower runs, Hastings to the Grant-Greene district line where the axis of the arch dies down. The logs of the following wells, scattered throughout the field, give important data concerning **both oil and gas** horizons as well as **coal beds:**

F. B. Blake No. 1 Well Record (W 142), Grant District.

Located 2 miles southwest of Uniontown on head of Right fork of Fourmile run. Authority, Carnegie Natural Gas Co.

	Feet.	Feet.
Coal, Mapletown (Sewickley)	1060	
Coal, Pittsburg	1150	
Big Injun sand	2386	to 2600
Gordon Stray sand (gas at 3186 feet)	3168	
Gordon sand to bottom	3200	to 3217

Rock pressure, 705 pounds.

Jos. Province No. 1 Well Record (W 145), Grant District.

(Published in Vol. I (a), p. 180 of State Survey reports.)

Located 3½ miles due north of Mobley P. O. on head of Rockcamp run of North fork of Fishing creek. Authority, Carter Oil Co.

	Feet.		Feet.
Pittsburg Coal	1035	to	1050
Cave	1460	to	1530
Cow Run Sand	1510	to	1550
Salt Sand (water, 1915')	1780	to	1960
Maxton Sand	2035	to	2075
Pencil cave	2190	to	2200
Limestone	2200	to	2280
Big Injun Sand (gas. 2381')	2309	to	2589
Pencil cave	3060	to	3070
Gordon Stray	3070	to	3100
Gordon sand, poor	3100	to	3105
Total depth	3211		

Good gas well in "Stray" Sand.

Top of **Pittsburg coal** to **Maxton sand**	1000
Top of **Pittsburg coal** to **Big Injun sand**	1274
Top of **Pitsburg coal** to **Gordon Stray sand**	2035
Top of **Pittsburg coal** to **Gordon sand**	2065

Gas was encountered in this well in both the Big Injun and Gordon Stray sands. The Pittsburg coal appears to have a thickness of 15 feet, but two other wells in this region report 12 and 11 feet of Pittsburg coal; viz., the S. B. Higginbotham No. 1 well (W 140), located near the mouth of Big run, 1 mile northeast of Lowman P. O. (Kingtown) and the L. Higginbotham No. 1 well (W 143), located on Willey fork, 1 mile above the mouth of Big run.

Lititia Lacox No. 1 Well Record (W 135), Grant District.

Located 1 mile north of Jacksonburg on Upper run. Authority, Philadelphia Company.

	Top Feet.	Thickness Feet
Coal, Washington	158	2
Coal, Pittsburg	not recorded	
Big Injun sand	1915	135
Squaw sand	2100	50
Gordon sand? (**Thirty-foot**)	2550	75
Fifth sand? (**Gordon**)	2730	20

Gas in Gordon sand (**Thirty-foot**).
Pressure at 1 minute, 30 lbs.
Pressure at 10 minutes, 205 lbs.
Pressure at 30 minutes, 460 lbs.

The Pittsburg coal bed was not recorded in this well since it is close the approximate western boundary line where this coal of commercial thickness and purity disappears, shown on the economic geology map accompanying this report in a separte cover. It, however, belongs about 1275 feet above the top of the Big Injun sand as shown by

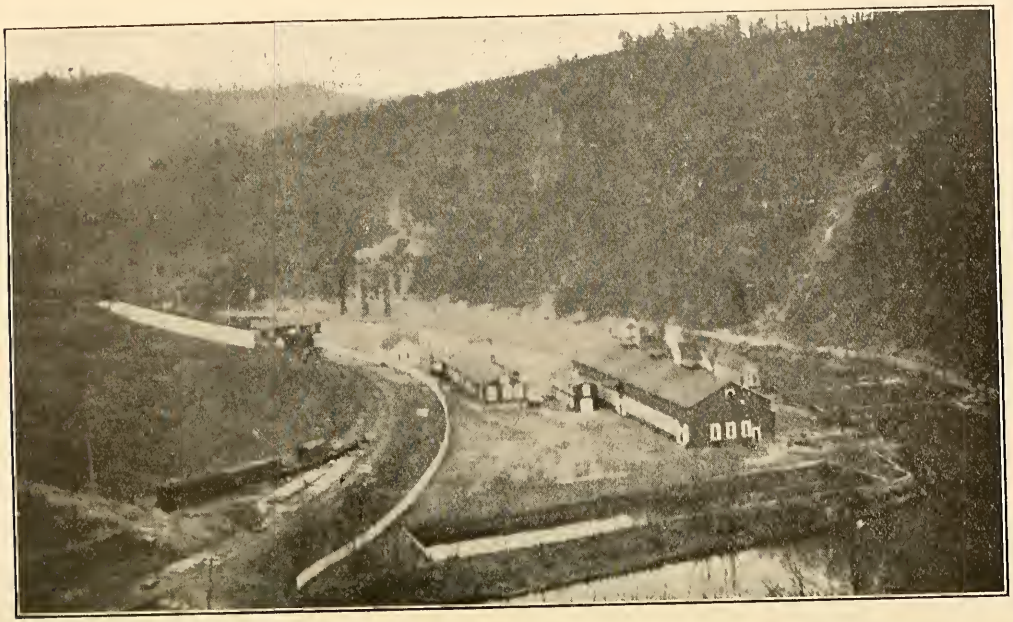

Plate IX.—Largest Natural Gas Pumping Station in the World, Located at Hastings, Wetzel County (See page 23.)

other well records near by, and should come at a depth of 640 feet. It is very evident then that the sands identified here as the **Gordon** and **Fifth** by the drillers correlate with the **Thirty-foot** and **Gordon** respectively, and are so designated in parentheses by the writer.

F. M. Watson No. 1 Well Record (W 132), Grant District.

Located at Hastings on south side of Fishing creek. Authority, Philadelphia Compnay.

	Top Feet.	Thickness Feet
Coal, Native, Washington	135	(2)
Coal, Pittsburg	612	(3)
Gordon Stray sand	2665	(20)
Gordon sand	2698	(18)

Gas at 2690 and 2710 feet.
Rock pressure at 24 hours, 1100 lbs.

The following detailed well record is taken from Vol. I of the State Survey reports. This is a very important record and is republished here since the edition of the report referred to is exhausted:

D. H. Cox No. 1 Well Record (W 136), Grant District.

Located on Upper run, 2 miles southwest of Lowman P. O. (Kingtown). Authority, South Penn Oil Co.

	Thickness Feet.	Total Feet.
Conductor	16 to	16
Limestone, blue, hard	30 to	46
Soapstone	10 to	56
Limestone, blue	30 to	86
Sand, white	10 to	96
Soapstone	31 to	127
Coal, (Washington)	3 to	130
Soapstone	140 to	170
Limestone, white	20 to	190
Sand, reddish	6 to	196
Soapstone	16 to	212
Slate, black	20 to	232
Red rock	4 to	236
Limestone, white	8 to	244
Limestone, sandy	10 to	254
Soapstone	20 to	274
Slate, black	12 to	286
Soapstone	15 to	301
Slate, black	18 to	319
Red rock	35 to	354

	Thickness Feet.	Total Feet.
Soapstone	9 to	363
Limestone, sandy	5 to	368
Slate, black	4 to	372
Limestone, black	5 to	377
Sand and limestone	4 to	381
Slate	25 to	406
Limestone	43 to	449
Slate	4 to	453
Sand	5 to	458
Limestone	67 to	525
Sand and shells	10 to	535
Slate, black	20 to	555
Limestone	21 to	576
Slate	11 to	587
Red rock	5 to	592
Pitsburg coal	16 to	608
Red rock	4 to	612
Slate	4 to	616
Red rock	25 to	641
Limy sand	16 to	657
Slate	10 to	667
Limestone	18 to	685
Slate	24 to	709
Limestone	30 to	739
Slate	23 to	762
Limestone	12 to	774
Red rock	20 to	794
Limestone	30 to	824
Limestone, red	15 to	839
Limestone	10 to	849
Sand	22 to	871
Limestone	40 to	911
Sand	30 to	941
Limestone	20 to	961
Slate and shells	10 to	971
Red rock	20 to	991
Limestone	5 to	996
"Cave"	5 to	1001
Slate and sand shells	35 to	1036
Sand	10 to	1046
Slate	5 to	1051
Red rock	25 to	1076
Limestone	20 to	1096
Slate	40 to	1136
Limestone	40 to	1176
Slate and shells	38 to	1214
Slate	17 to	1231
Sand	44 to	1275
"Cave"	5 to	1280
Slate	10 to	1290
Sand	50 to	1340
Slate and shells	15 to	1355
Slate	22 to	1377
Sand, gray	40 to	1417

		Thickness Feet.	Total Feet.
Sand		62 to	1479
Slate		63 to	1542
Sand	**Salt**	10 to	1552
Sand shells and limestone	**Sands**	35 to	1587
Sand		50 to	1637
Slate, black		63 to	1700
Red rock		10 to	1710
Sand (gas) (Maxton)		56 to	1766
"Pencil" slate		15 to	1781
Limestone		91 to	1872
"Big Injun"	sand and limestone 20; sand, grayish white 12; slate 2; sand, hard, white 26; sand, dark gray 18; sand, white 5; sand, dark rgay 15; sand, white, (gas at 1972') 45; sand, gray 8; slate 4; sand 150	305 to	2177
Slate and shells		15 to	2192
Sand, **(Squaw)** and **(Berea)**		180 to	2372
Slate and shells		20 to	2392
Sandy beds **(Gantz and "Fifty-foot")**		160 to	2552
Sand **(Thirty-foot)**		50 to	2602
Slate		30 to	2632
Sand, **("Gordon Stray")**		68 to	2700
Slate and shells		75 to	2775
Slate		40 to	2815
Sand **(Flat Run "Gordon," Fourth)**		2 to	2817
Slate		20 to	2837
Sand (gas) **McDonald, Fifth**		1 to	2838
Slate		18 to	2856
Slate and shells		188 to	3044
Top of Pittsburg coal to **Maxton sand**			1118
Top of Pittsburg coal to **Big Injun sand**			1280
Top of Pittsburg coal to **Squaw and Berea sand**			1600
Top of Pittsburg coal to **Gantz and Fifty-foot sand**			1800
Top of Pittsburg coal to **Thirty-foot sand**			1960
Top of Pittsburg coal to **Gordon Stray**			2040
Top of Pittsburg coal to **Fourth**			2222
Top of Pittsburg coal to **Fifth**			2245

Gas was encountered at three horizons in this well; viz., **Maxton**, **Big Injun**, and **Fifth** sands. The Gordon sand should come in the 75 feet of **slate and shells**, coming 2700 feet from the top. Although this record is taken in detail, only the Washington and Pittsburg coals are given. This bears out the log of the **diamond drill borings** at Mobley P.

O. (W 150) and Jacksonburg (W 177), published on pages 278 and 276 respectively.

Directly east from the axis of the Burchfield syncline at Mobley P. O. there occurs a Big Injun sand oil pool of 50 to 75 wells, extending southward on to the heads of Richwood and Fallen Timber runs. The record of the Annie Muffney No. 1 well (W 148), published in Vol. I (a), page 196, of the State Survey reports shows the oil and gas horizon and also that the thickness of the Monongahela series is about 355 feet in this portion of Grant district. Immediately on the east of the Mobley oil field there occurs another gas belt along the crest of the Hundred anticline. The following well record gives the gas horizons:

James Furbee No. 1 Well Record (W 152), Grant District.

Located on Willey fork, 2 miles No. 80°-85°. E. of Mobley P. O. Authority, Carnegie Natural Gas Co.

	Feet.
10" casing	260
8" casing	1120
6½" casing	1860
Packed with 2" tubing	1927

	Top Feet.	Thickness Feet
Coal, Pittsburg	612	
Big Injun sand	1900	200
Gas at 1990 feet; 2 hrs. 500 lbs.		
Gordon sand	2700	
Salt sand gas at 1400 feet between 6⅝" and 8¼" casing.		
Rock pressure at 1 minute 35 lbs.		
Rock pressure at 10 minutes 400 lbs.		
Small gas well in Salt sand and Big Injun sand.		

In the vicinity of Smithfield on Fishing creek, the Hundred anticline has died down and flattened out, forming what the writer has termed the **Smithfield terrace** (see page 64). A great oil pool is found on this terrace in both the Big Injun and Gordon sands. The following record of a well published in Vol. I (a), page 196, of the W. Va. Geol. Survey Reports, gives one of the oil horizons:

I. D. Morgan No. 11 Well Record (W 159), Grant District.

Authority, South Penn Oil Co.

	Feet.	Feet.
[illegible] Coal	650 to	660
Dunkard Sand	1150 to	1190

	Feet.		Feet.
"Gas" Sand (II Cow Run)	1400	to	1448
Salt Sand	1570	to	1660
cave	1870	to	1880
Big Lime	1880	to	1945
Big Injun sand (oil, 2031′)	1945	to	2043

John Stevens No. 20 Well Record (W 204), Grant District.

Located 1 mile southwest of Smithfield. Authority, South Penn Oil Co.

	Feet.		Feet.
Pittsburg coal	1130	to	1137
Salvation sand (Maxton)	2330	to	2340
Big Lime	2340	to	2430
Big Injun sand (oil)	2430		

	Feet.
Top of **Pitsburg coal** to **Maxton sand**	1200
Top of **Pittsburg coal** to **Big Injun sand**	1300

H. L. Smith No. 1 Well Record (W 207), Grant District.

On head of Morgan run, 2 miles south of Smithfield. Authority, Wheeling Natural Gas Co.

	Feet.		Feet.
Pittsburg coal	760	to	771
Little Dunkard? sand **(Murphy), (Morgantown)**	975	to	1000
Big Dunkard sand	1240	to	1260
Hurry-up sand **(Lower Freeport)**	1360	to	1420
Gas sand **(II Cow Run)**	1500	to	1600
Salt sand	1620	to	1780
Little lime sand **(Maxton?)**	1985	to	2000
Pencil cave	2000	to	2005
Big lime	2005	to	2065
Big Injun sand (gas in sand at 2155′)	2065	to	2245
Sand and shells	2550	to	2680
Thirty-foot sand	2785	to	2815
Stray sand	2833	to	2845
Gordon sand (gas from 2851 to 2863 feet)	2851	to	2863
Unrecorded to bottom	2863	to	2882
Top of **Pittsburg coal** to **Murphy sand**			215
Top of **Pittsburg coal** to **II Cow Run sand**			740
Top of **Pittsburg coal** to **Big Injun sand**			1305
Top of **Pittsburg coal** to **Thirty-foot sand**			2025
Top of **Pittsburg coal** to **Gordon Stray sand**			2073
Top of **Pittsburg coal** to **Gordon** sand			2091

This well is located on the nose of the Arches fork anticline and is too high up the slope for oil, but gas was found in both the Big Injun and Gordon sands.

The following is the record of a well located near the eastern edge of the "Smithfield terrace." Oil is encountered

in both the Big Injun and Gordon sands as well as an abundant gas supply in the Gordon Stray:

J. S. Stout No. 2 Well Record (W 208), Grant District.

Located 2 miles southeast of Smithfield on Stout run. Authority, South Penn Oil Co.

	Feet.		Feet.
Pittsburg Coal	825	to	831
Dunkard Sand	1325	to	1350
Salt Sand	1700	to	1809
Red rock	1945	to	2005
Pencil cave	2020	to	2026
Big Lime	2036	to	2143
Big Injun Sand (oil, 2223')	2143	to	2263
"Fifty-foot" Sand	2825	to	2855
"Thirty-foot" Sand	2880	to	2900
Stray Sand (gas, heavy, 2918')	2915	to	?
Gordon Sand (oil, 2964 to 2965')	2953		
Total depth	2973		
Top of **Pittsburg coal** to **Dunkard sand**			500
Top of **Pittsburg coal** to **Salt sand**			875
Top of **Pittsburg coal** to **Big Injun sand**			1318
Top of **Pittsburg coal** to **Fifty-foot sand**			2060
Top of **Pittsburg coal** to **Thirty-foot sand**			2055
Top of **Pittsburg coal** to **Gordon Stray sand**			2090
Top of **Pittsburg coal** to **Gordon sand**			2128

From the mouth of Stout run southeast up Fishing creek to Folsom and Robinson there occur a large number of Big Injun and Gordon sand wells. The abbreviated records of W 209, W 210, W 211, and W 212 are found in the table of Wetzel county wells on page 404, as well as the brief logs of wells W 218, W 219, W 220, W 221, W 222, W 223 and W 225 scattered northeast from Robinson along both flanks of the Robinson syncline to the Wetzel-Marion county line; also of wells W 154 and W 155 near Brink P. O. South from Robinson and Folsom along the eastern slope of the Arches Fork anticline are found several Gordon sand oil wells. The abbreviated record of well (W 215) is given in the Wetzel county table of wells on page 404. Farther up on the slope of this arch to the westward occurs a fine gas field. The record of the two following wells on Trader fork gives the horizon in which the gas is encountered:

Taylor Ruble No. 1 Well Record (W 214), Grant District.

Located on Trader fork, one mile and a half south of Folsom. Authority, Carnegie Natural Gas Co.

	Feet.	Feet.
Coal, Washington	290	
Coal, Redstone	780	
Coal, Pittsburg	810	
Big Injun sand	2100	to 2180
Gordon Stray sand (gas)	2830	to 2858
Gordon sand	2880	

Pressure of well in 6⅝" casing:
At ½ minute 75 lbs.
At 1 minute 140 lbs.—196 lbs.
At 3 minutes 365 lbs.—415 lbs.
At 4 minutes 465 lbs.—515 lbs.
At 5 minutes 540 lbs —590 lbs.
Final rock pressure 930 lbs.

Elma J. Bates No. 1 Well Record (W 219), Grant District.

Located on head of Trader fork, 2.8 miles S. 5°-10° W. of Folsom. Authority, Carnegie Natural Gas Co.

	Feet.	Feet.
Coal Pittsburg	955	
Big Injun sand (gas)	2245	to 2350
Rock pressure (24 hrs.) 730 lbs.		
Gantz sand	2826	to 2852
Fifty-foot sand	2970	to 2995
Gordon Stray sand to bottom (gas)	2998	to 3041
Top of Pittsburg ocal to Big Injun sand	1290	
Top of Pittsburg coal to Gantz sand	1871	
Top of Pittsburg coal to Fifty-foot sand	1915	
Top of Pittsburg coal to Gordon Stray sand	2043	

The Burchfield syncline crosses Fishing creek near Archer at the mouth of Arches fork. About one-half mile east of the latter point the Philadelphia Company drilled a dry hole on the Headley farm on the north side of Fishing creek in which the Pittsburg coal was not noted, although the Sewickley coal is given as 6 feet thick. The record of the Headley well is as follows:

G. W. Headley No. 1 Well Record (W 179), Grant District.

On Fishing creek, 3⅓ miles S. E. of Jacksonburg and ½ mile east of Archer. Authority, Philadelphia Company.

	Top Feet.	Thickness Feet
Coal, (Sewickley or Redstone)	712	6
Coal, Pittsburg, (supplied)	760	
Big Injun sand	2050	175
Gordon Stray sand	2800	10
Gordon sand	2813	10
Fourth sand	2858	20
Fifth sand	2945	20

The driller called the coal coming at 712 feet the Pittsburg, but the interval down to the top of the Big Injun sand, 1342 feet, appears too great, since the records of W 189, W 160, and W 180 on the southwest, southeast and northwest give the interval from the top of the Pittsburg coal down to the Big Injun sand as 1303, 1303 and 1260 feet respectively.

About one mile northwest of the Headley well W. Clark et al. of Marietta, Ohio, drilled a well on the Lewis Wyatt land (W 178). Mr. Wyatt informed the writer that a driller on this well said there was no coal at the horizon of the Pittsburg bed, but that he found over a foot of black slaty blossom instead. These two wells and the logs of the core test wells, W 177, W 174, W 128, and W 231, scattered down Fish creek to the mouth of Shenango creek, constitute the data for drawing the approximate western boundary line where the Pittsburg coal of commercial thickness and purity disappears, to the east of Archer.

The following is the record of a well located within 25 feet of the M. V. Anderson core test well (W 177) (page 276):

M. V. Anderson No. 11 Well Record (W 180), Grant District.

North bank of Fishing creek, 1 Mile S. E. of Jacksonburg. Authority, Carter Oil Co.

	Top Feet.	Thickness Feet.
Coal, Pittsburg	520	5
Cave (reds)	950	60
Cow Run? sand (Dunkard)	1020	40
Salt sand (water at 1320')	1250	225
Maxton sand	1635	40
Cave	1715	5
Big Lime	1725	50
Big Injun sand	1780	200
Gantz sand	2396	7
Gordon Stray sand	2581	15
Gordon sand	2596	33
Oil at 2596 and 2628 feet.		
Total depth	2643	

	Feet.
Top of **Pittsburg** coal to **Dunkard sand**	500
Top of **Pittsburg** coal to **Maxton sand**	1115
Top of **Pittsburg** coal to **Big Injun sand**	1260
Top of **Pittsburg** coal to **Gantz sand**	1876
Top of **Pittsburg** coal to **Gordon Stray sand**	2061
Top of **Pittsburg** coal to **Gordon sand**	2076

South of Jacksonburg in the southwest corner of Grant district, there occurs a large oil pool on the Lantz and Jno. Mills tracts of land, containing over 100 wells in the Big Injun and Gordon sands. This pool is located around the nose of the Littleton anticline and on the northeast portion of what the writer has termed the Stringtown terrace (see page 64). The records of the following wells from the mouth of Buffalo run to its head are of interest:

Samuel Lantz No. 1 Well Record (W 181), Grant District.

On Buffalo run, ⅓ mile S. W. of Jacksonburg. Authority, Kanawha Oil Co.

	Feet.	Feet.
Coal, Pittsburg	477	
Big Injun sand	1755	to 1963
Gordon sand	2538	to 2585
First gas	2548	
First oil	2577	
Total depth		2664

Samuel Lantz No. 8 Well Record (W 182), Grant District.

On Buffalo run, 6-10 mile south of Jacksonburg. Authority, Kanawha Oil Co.

Washington coal (bottom) by hand level 770′ A. T. or 2 feet above well mouth. Top of well (Hand level) 768′ A. T.

	Feet.	Feet.
Pitsburg coal (310′ A. T.)	458	
Big Injun sand (gas at 1778′)	1773	to 1995
Show of oil at 1806 feet.		
Gordon Stray sand	2551	
Gordon sand (gas and oil at 2571′)	2568	to 2593
Total depth		2604

The **Pittsburg coal** does not appear to be valuable on Buffalo run, and in the many wells drilled on the stream only the depth to the Pittsburg coal horizon is given and no thickness being recorded.

John Mills No. 3 Well Record (W 183), Grant District.

On branch of Buffalo run, 1.4 mile S. W. of Jacksonburg. Authority, Kanawha Oil Co.

	Feet.	Feet.
Pittsburg coal	590	
Big Injun sand	1895	to 2125
Gordon sand	2670	
Gas at 2687 feet; gas and oil at 2694 feet.		

	Feet
Bottom of hole	2752
Top of **Pittsburg coal** to **Big Injun sand**	1305
Top of **Pittsburg coal** to **Gordon sand**	2080

John Mills No. 30 Well Record (W 184), Grant District.

On Buffalo run, 1.2 mile S. E. of Jacksonburg. Authority, Kanawha Oil Co. Top 790′ A. T.

	Feet
Pittsburg coal (255′ A. T.)	535
Big Injun sand	1835
Gas and oil	1841
Gordon sand	2632
Oil and gas	2634
Total depth	2652

John Mills No. 88 Well Record (W 185), Grant District.

On Buffalo run, 1.5 miles S. E. of Jacksonburg. Authority, Kanawha Oil Co.

	Feet.	Feet.
Coal, Sewickley	552	
Coal, Pittsburg (223′ A. T.)	582	
Big Injun sand	1880	to 2080
Stray sand	2648	
Oil show	2658	
Gordon Sand	2668	to 2697
Oil show	2682	
Total depth		2703

John Mills No. 48 Well Record (W 186), Grant District.

On Buffalo run, 2 miles S. E. of Jacksonburg. Authority, Kanawha Oil Co. Top 818′ A. T.

	Feet
Coal (Redstone)	577
Coal, Pittsburg (203 A. T.)	615
Big Injun sand	1930
Gordon Stray sand	2668
Gordon sand	2688
Oil and gas	2691
Total depth	2706
Top of **Pittsburg coal** to **Big Injun sand**	1315
Top of **Pittsburg coal** to **Gordon Stray sand**	2053
Top of **Pittsburg coal** to **Gordon sand**	2073

John Mills No. 68 Well Record (W 187), Grant District.

On Buffalo run, 2.2 miles southeast of Jacksonburg. Authority, Kanawha Oil Co. Top 820′ A. T.

	Feet.	Feet.
Pittsburg coal (202′ A. T.)	618	
Gordon Stray sand	2670 to	2697
Gordon sand	2699 to	2725
Oil show	2704	
Oil and gas	2717	
Total depth		2728

John Mills No. 71 Well Record (W 188), Grant District.

On Buffalo run, 2.4 miles S. E. of Jacksonburg. Authority, Kanawha Oil Co. Top 834′ A. T.

	Feet.	Feet.
Pittsburg coal (204′ A. T.)	630	
10″ casing, 386 feet. 8″ casing, 1163 feet.		
Big Injun sand	1940 to	2135
Gordon Stray sand	2709	
Gordon sand	2730 to	2755
Oil show	2734	
Total depth		2773
Top of **Pittsburg coal** to **Big Injun sand**		1310
Top of **Pittsburg coal** to **Gordon Stray sand**		2079
Top of **Pittsburg coal** to **Gordon sand**		2100

Ezra Hays No. 1 Well Record (W 189), Grant District.

On Buffalo run, ⅓ mile above Campbell run. Authority, Kanawha Oil Co.

	Feet.	Feet.
Pittsburg coal (1′)	877 to	878
Big Injun sand	2180 to	2375
Water and gas at 2210′.		
Gordon Stray sand	2974 to	3007
Oil show at 2994′.		
Total depth (dry)		3112
Top of **Pittsburg coal** to **Big Injun sand**		1303
Top of **Pittsburg coal** to **Gordon Stray sand**		2097

The poor character of the Pittsburg coal bed in this portion of Grant district is well exhibited in the above record where it is shown to have a thickness of only 1 foot.

The following is the record of a Maxton sand oil well in this portion of Grant district:

Hart Bros. No. 6 Well Record (W 191), Grant District.

On Buffalo run, ⅓ mile above mouth of Campbells run. Authority, Kanawha Oil Co. Top 897′ A. T.

	Feet.	Feet.
Pittsburg coal (230′ A. T.)	667	
Maxton sand (oil at 1855′)	1829 to	1864
Total depth		1878
Shot with 10 qts. of glycerine.		

Hart Bros. Nos. 7 and 8 on the same farm are also Maxton sand oil wells and in each there occurs 20 feet of good pay sand.

GREEN DISTRICT.

Green district lies immediately on the west of Grant and its area is traversed in a northeast-southwest direction by three structural folds: viz., the Big Moses anticline, the southern termini of the Nineveh, annd Loudenville (Finney) synclines, and the Washington anticline. Its largest oil field is located on Piney fork on the eastern slope of the Big Moses anticline and on the northern portion of the Stringtown terrace. The principal oil horizons of this field are the Big Injun and Gordon sands. The records of the following wells, 7 in number, are of special interest. The depth to the Pittsburg coal only is given, the thickness not reported, since as a rule a coaly blossom 1 to 2 feet thick is all that is generally encountered in the wells. In some wells the drillers are not able to recognize its horizon:

E. A. Booth No. 4 Well Record (W 243), Green District.

On Piney fork, 1.3 mile S. E. of Piney P. O. Authority, South Penn Oil Co.

	Feet.	Feet.
Coal, Pittsburg (241′ A. T.)	659	
Big Injun sand	1958	to 2130
Gas pay at 2048′.		
Gordon Stray sand	2711	
Oil show	2721	
Gordon sand	2735	to 2753
Oil at 2743′.		
Top of **Pittsburg coal** to **Big Injun sand**		1299
Top of **Pittsburg coal** to **Gordon Stray sand**		2052
Top of **Pittsburg coal** to **Gordon sand**		2076

Geo. V. Reilly No. 1 Well Record (W 244), Green District.

On Piney fork, 2 miles S. E. of Piney P. O. Authority, South Penn Oil Co. Well mouth, 901′ A. T.

	Feet.	Feet.
Coal, Pittsburg (233′ A. T.)	668	
Big Injun sand	1995	to 2100

	Feet.	Feet.
Gordon sand	2742 to	2750
Oil at 2742'.		
Shelly and hard	2765	
Total depth		2805

Henry Nolan No. 7 Well Record (W 245), Green District.

Near head of Piney fork, 2.8 miles S. E. of Piney P. O. Authority, South Penn Oil Co. Top (Hand level) 941' A. T.

	Feet.	Feet.
Coal, Pittsburg (176' A. T)	765	
Big Injun sand	2090 to	2225
Gordon Stray sand	2813	
Gordon sand	2834	
First pay at 2835'; second pay at 2851'.		
Total depth		2869

	Feet.
Top of **Pittsburg coal** to **Big Injun sand**	1325
Top of **Pittsburg coal** to **Gordon Stray sand**	2048
Top of **Pittsburg coal** to **Gordon sand**	2069

Henry Nolan No. 2 Well Record (W 246), Green District.

On head of Piney fork, 3 miles S. E. of Piney P. O. Authority, South Penn Oil Co. Top, 960' A. T.

	Feet.	Feet.
Conductor	to	16
10-inch casing		440
8¼-inch casing		1318
6⅝-inch casing		1701
5 3-16-inch casing		2911
Coal, Pittsburg (206' A. T.)	754	
Big Injun sand	2079 to	2229
Gordon Stray sand (pay at 2839')	2836	
Gordon sand (oil pay at 2866')	2850 to	2867
Total depth		2895

The pay noted at 2839 feet in the **Gordon Stray** probably refers to gas and not oil, since the latter bed is a great gas horizon in this field.

Sol. H. Wiley No. 1 Well Record (W 242), Green District.

On Fluharty fork of Piney fork. 1 mile south of Piney P. O. Authority, South Penn Oil Co. Top, 823' A. T.

	Feet.	Feet
Coal. Pittsburg (253' A. T.)	570	
Big Injun sand	1895 to	2050
Gordon Stray sand (gas at 2603')	2602	
Gordon sand	2625	
Break of slate	2632	
Oil pay	2660	

	Feet.
Total depth	2665
	Feet
Top of **Pittsburg coal** to **Big Injun sand**	1325
Top of **Pittsburg coal** to **Gordon Stray sand**	2032
Top of **Pittsburg coal** to **Gordon sand**	2055

David M. Cunningham No. 4 Well Record (W 249), Green

Located on Fluharty fork of Piney fork, 2 miles S. of Piney P. O. Authority, South Penn Oil Co.

	Feet.	Feet.
Coal, Pittsburg	645	
Big Injun sand	1950 to	2150
Gordon Stray sand (oil at 2727')	2725 to	2747
Gordon sand	2755 to	2769
Oil at 2759' (Good sand but no increase of oil)		
Total depth		2780

In this well the Gordon Stray appears to be the best oil horizon.

Wm. Fluharty No. 9 Well Record (W 248), Green District.

Located on Fluharty fork of Piney fork, 2.6 miles S. 5°-15° E. of Piney P. O. Authority, South Penn Oil Co.

	Feet.	Feet.
Coal, Pittsburg	780	
Big Injun sand	2107 to	2272
Gordon Stray sand (oil show at 2838')	2836 to	2853
Gordon sand (oil at 2862')	2856 to	2871
Total depth (Sept. 23, 1899)		2920
Drilled deeper March 3, 1905		
Fourth sand	2945 to	2950
Fifth sand? (limy nature; no oil), (Bayard)	3105 to	3109
Total depth		3210
Abandoned.		
Top of **Pittsburg coal** to **Big Injun sand**		1327
Top of **Pittsburg coal** to **Gordon Stray sand**		2056
Top of **Pittsburg coal** to **Gordon sand**		2076
Top of **Pittsburg coal** to **Fourth sand**		2165
Top of **Pittsburg coal** to **Bayard sand**		2325

This well produced oil from the Gordon Stray and Gordon sands for 5 or 6 years and then was drilled deeper and abandoned. The sand identified by the driller as **Fifth**, coming 2325 feet below the Pittsburg coal, appears to represent the Bayard being too deep for the Fifth sand.

Northwest of the Piney fork oil region there occurs a great gas field along the crest and a short distance down both flanks of the Big Moses anticline. This field is located mostly

on the waters of Crow, Brush, and State runs on the south side of Fishing creek, and on Trough run and Shenango and Reader creeks on the north side. The records of the following wells from south to north show the principal gas horizons. The Pittsburg coal bed is reported generally thin and of no economic value, but its depth is usually reported when recognized on account of its great value as a key rock.

J. R. Haught No. 1 Well Record (W 251), Green District.

On head of Brush run, 1-5 mile N. of Atwood P. O. on Wetzel-Tyler county line. Authority, Carnegie Natural Gas Co.

	Feet.	Feet.
Pittsburg coal not recorded.		
Big Injun sand not recorded.		
Gordon Stray sand	2959 to	2974
Total		2974
Pressure at 1 minute 160 lbs., 6⅝" casing.		
Pressure at 15 minutes 600 lbs.		

W. J. Kennedy No. 1 (W 253), Green District.

Located on ridge between Brush and State runs, 3.1 miles southeast of Porters Falls. Authority, Tri-State Gas Co.

	Feet.	Feet.
Pittsburg coal	880	
Big Dunkard sand	1380 to	1420
Gas sand	1480 to	1600
Salt sand	1760 to	1865
Maxim sand (Maxton)	1940 to	1965
Blue Monday sand	2060 to	2090
Lime	2090 to	2180
Big Injun sand	2180 to	2400
Gordon (Gordon Stray)	2936	
Gas pay	2950	
Bottom		3005
Top of **Pittsburg coal** to **Maxton sand**		1060
Top of **Pittsburg coal** to **Blue Monday sand**		1180
Top of **Pittsburg coal** to **Big Injun sand**		1300
Top of **Pittsburg coal** to **Gordon Stray sand**		2056

Thos. O'Brien No. 2 Well Record (W 255), Green District.

Located on Brush run, 1.4 mile south of Reader. Authority, Tri-State Gas Co.

	Feet.	Feet.
Coal, Pittsburg	444	
Big lime	1649 to	1729
Keener sand	1729 to	1850
Big Injun sand	1850 to	1950
Gordon Stray sand (gas at 2560')	2556 to	2571
Total depth		2603

J. R. Woods No. 2 Well Record (W 257), Green District.

Located near summit of west hill side of Brush run. 1 mile S. 15°-20° W. of Reader. Authority, G. A. Fulton, foreman for Hope Natural Gas Co.

	Feet.		Feet.
Native coal, (Washington)	490		
Mapletown coal (Sewickley)	850	to	853
Pittsburg coal	925	to	927
Murphy sand? (Connellsville)	996	to	1014
Little Dunkard sand	1446	to	1486
Big Dunkard sand? (Lower Freeport)	1545	to	1570
Gas sand (II Cow Run?)	1610	to	1660
Salt sand	1893	to	2000
Maxim sand (Maxton)	2056	to	2090
Pencil cave	2101	to	2110
Blue Monday	2110	to	2132
Big lime	2132	to	2177
Big Injun sand	2177	to	2410
Red rock	2860	to	2920
Gordon Stray sand	2999	to	3003
First gas, top of Gordon sand	3004	to	3033
Second gas	3021		
Red rock	3033	to	3580
Sand to bottom (Speechley? I and II Warren? or Tiona?)	3580	to	3625
Top of Pittsburg coal to II Cow Run sand			685
Top of Pittsburg coal to Maxton sand			1131
Top of Pittsburg coal to Blue Monday			1185
Top of Pittsburg coal to Big Injun sand			1252
Top of Pittsburg coal to Red rock			1935
Top of Pittsburg coal to Gordon Stray sand			2074
Top of Pittsburg coal to Gordon sand			2079
Top of Pittsburg coal to red rock			2108
Top of Pittsburg coal to Speechley? etc.			2655

The Pittbsurg coal bed is reported only 2 feet thick in this well. The Blue Monday is a very hard limy sand, evidently coming between the Pencil cave and the Big lime and may be the top portion of the latter bed. The gas horizon appears to be the Gordon sand.

The abbreviated records of wells W 234 and W 235 are found in the tabular list of Wetzel county wells on page 404

On the north side of Fishing creek a dry hole was drilled on the Lantz farm. Its record is as follows:

John Lantz No. 1 Well Record (W 233), Green District.

Located on Reader creek, 0.6 miles N. 60°-80° E. of Reader. Authority, Carnegie Natural Gas Co.

10-inch casing 175 feet.
8-inch casing 1100 feet.
6-inch casing 1835 feet.

	Feet.	Feet.
Coal, Pittsburg	480	
Big Injun sand	1745 to	2000
Gordon Stray sand	2528	
Gordon sand	2553 to	2570
Fourth sand	2600 to	2610
Total depth		2850

Dry hole.

One mile and a half northwest of the Lantz well, a light gas well was drilled on the Winning farm on a branch of Money run. Its record is as follows:

E. D. Winning No. 1766 Well Record (W 262), Green Dist.

Located on Money run, 1.6 mile N. W. of Reader. Authority, Philadelphia Company.

	Top Feet.	Thickness Feet
Coal, Pittsburg	555	5
Big Dunkard sand	1070	30
Big Injun sand (gas, light)	1772	245
Gordon sand	2618	1

Considered dry and abandoned, but the writer found quite a flame burning at the well mouth.

About one mile and a qaurter S. 60°-75° W. of Reader, Hervey & McNutt recently opened up a small Big Injun sand oil pool. consisting of 4 or 5 producing wells. Ida Cochran No. 2 (W 259) had an initial production of 200 bbls. a day. The other wells were light, 5 to 10 bbls. The pool is now almost surrounded with dry holes.

The following is the record of a Maxton sand oil well drilled in during 1908:

Abrigg No. 1 Well Record (W 263), Green District.

Located 1 mile N. 50°-60° E. of Porters Falls. Authority, W. C. Marshall, a driller on well.

	Feet.	Feet.
Red rock, slate, and lime	0 to	465
Native coal (Uniontown)	465 to	469
Slate and limestone	469 to	635
Mapletown coal (Sewickley)	635 to	640
Broken formation	640 to	704
Coal (Redstone)	704 to	709

	Feet.		Feet.
Limestone	709	to	713
Pittsburg coal	713	to	720
White and black slate, red rock and lime	720	to	1170
Dunkard sand	1170	to	1210
Black slate	1210	to	1240
Gas sand	1240	to	1280
Black slate	1280	to	1400
Salt sand	1400	to	1460
Black slate	1460	to	1510
Salt sand	1510	to	1600
Black shale and lime	1600	to	1660
Lime and sand; gas in bottom	1660	to	1760
Black slate	1760	to	1780
Maxton sand (gas at 1780'; oil at 1794½')	1780	to	1802½

One of the drillers on this well informed the writer that the 7 feet of Pittsburg coal was partly black slate and that they could not tell just what thickness was actual coal. A diamond drill boring (W 269) put down on the Steel farm, slightly over a mile northwest of the Abrigg No. 1 well (W 263), on Little Fishing creek found only 2 feet 10 inches of Pittsburg coal, according to Alonzo Sidell, of New Martinsville W. Va., one of the interested parties in the test.

The following is the log of a dry hole drilled close by the core test:

Wm. Hart No. 1 Well Record (W 268), Green District.

Located on Little Fishing creek, 1.5 mile due north of Porters Falls. Authority, J. P. Chaplin of New Martinsville W. Va. Top, 663' A. T.

	Feet.	Feet.
Coal No. 12 (**Washington**)	69	
Coal, Pittsburg	533	
Showing of gas and oil	1815	
Total depth	1910	

The gas and oil occurred in the Big Injun sand. The top of the latter bed is not given in the log. Three or four other dry holes have been drilled in the western end of Green district in the deep structural basin east of the mouth of Little Fishing creek.

PROCTOR DISTRICT.

Proctor district lies north of Green and west of Center, and its area is traversed by three structural folds: viz., the

Washington and New Martinsville anticlines, and the Loudenville (Finney) syncline, the latter being the trough or basin between the other two arches. The main oil field of the district is the old "Garner pool" extending southwestward along the eastern slope of the New Martinsville anticline from the Marshall-Wetzel county line to Marion P. O. on Proctor creek. This field is an extension of the Gordon sand oil belt of Meade district, Marshall county.

The records of the following wells from north to south give valuable data concerning the oil and gas horizons and the coal beds:

H. R. Thompson No. 1 Well Record (W 290), Proctor Dist.

Located ½ mile E. of Peabody P. O. and 1.2 miles S. of Marshall-Wetzel county line. Authority, South Penn Oil Co.

	Feet.	Feet.
Coal, (Washington)	726 to	730
Coal, (Sewickley)	1060 to	1067
Coal, Pittsburg	1155 to	1161
Big Injun sand	2270 to	2585

Top of Pittsbug coal to Big Injun sand 1115 feet.

As in Meade district, Marshall, the Sewickley coal in this portion of Proctor district appears to be as important so far as revealed by oil well borings as the Pittsburg bed.

John Huggins No. 4 Well Record (W 288), Proctor District.

Located 1.5 mile N. E. of Marion P. O. on branch of Proctor creek. Authority, Iseman Oil Co.

	Feet.	Feet.
Coal, Waynesburg	445	
(Coal, Pittsburg, supplied by writer)	(745)	
Salt sand	1490	
Big lime	1815 to	1880
Big Injun sand	1880 to	2180
Gordon sand	2768 to	2776

Oil in Gordon, and best well in field.

John Trader No. 1 Well Record (W 284), Proctor District.

Located on Proctor Creek, ¾ miles northwest of Marion P. O. Authority, Tri-State Gas Co. Completed June 29, 1903.

	Feet.	Feet.
Mapletown coal (Sewickley)	316	
Pittsburg coal	440	

	Feet.	Feet.
Big lime	1510 to	1570
Big Injun sand	1570 to	1810
Gordon sand	2455 to	2467
Top of Pittsburg coal to Big Injun sand		1130
Top of Pittsburg coal to Gordon sand		2015

The abbreviated records of wells W 291, W 289, W 286, W 287, and W 283 are found in the tabular list of Wetzel county wells on page 404. The record of the Anna Brachbuhlar No. 1 well (W 283), located on McCloud run of Proctor creek, ¾ mile southwest of Andy P. O., as published in the table of wells, was given the writer by Mr. Brachbuhlar, the husband of Anna. He said the drillers gave him those figures, and for this reason the western boundary line where Pittsburg coal of commercial thickness and purity exists is drawn to the westward on the economic geology map accompanying this report.

Northwest of the "Garner oil pool" in Proctor district, there occurs a fine gas field along the crest and a short distance down the slopes of the New Martinsville anticline. The principal gas horizon is the Gordon sand. The two following well records in this field are of special interest:

Jacob Yoho No. 1 (W 295), Proctor District.

Located 1.8 mile east of Proctor. Authority, Wheeling Natural Gas Co.

	Top. Feet.	Bottom Feet.
Native coal, (Washington)	400	402
Native coal, (Waynesburg)	520	524
Mapletown coal (Sewickley)	720	725
Pittsburg coal	810	815
Little Dunkard sand (I Cow Run)	1085	1120
Big Dunkard sand	1300	1320
Gas sand (Lower Freeport)	1340	1370
Salt sand (water at 1540')	1535	1575
Maxton sand	1790	1820
Big lime	1840	1895
Big Injun sand	1895	2210
Berea Grit? sand (Gantz)	2538	2553
Red rock	2643	2723
Slate	2723	2813
Gordon (gas)	2813	2862
Top of Pittsburg coal to I Cow Run sand		275
Top of Pittsburg coal to Maxton sand		980
Top of Pittsburg coal to Big Injun sand		1085

	Feet.
Top of Pittsburg coal to Berea? (Gantz) sand	1728
Top of Pittsburg coal to Red rock	1833
Top of Pittsburg coal to Gordon sand	2003

Since all the intervals show considerable thinning of the measures in this portion of Wetzel as compared to southeastern Grant district, it is quite possible that the sand identified by the drillers as the Berea Grit may represent the Gantz sand. The thickness of the Monongahela series here is shown to be 290 feet.

Mack Goudy No. 1 Well Record (W 296), Proctor District.

Located on Left fork of Proctor creek, 1.8 mile S. 80° W. of Proctor. Authority, Tri-State Gas Co. Completed March 15, 1904.

	Top. Feet.	Bottom Feet.
Mapletown coal (Sewickley)	280	
Pittsburg coal	370	
Little Dunkard sand	795	810
Big Dunkard sand	875	905
Gas sand	950	990
First Salt sand	1000	1060
Second Salt sand	1130	1200
Maxton sand	1280	1295
Big lime	1435	1505
Big Injun sand	1510	1820
Berea Grit sand	2085	2095
Gordon sand	2360	2370

A small Big Injun sand oil pool is found near Maud P. O. on Little Fishing creek on the eastern slope of the Washington anticline. The two following well records show the oil horizon:

J. A. Kocher No. 1 Well Record (W 280), Proctor District.

On Long run, ¼ mile N. of Maud P. O. Authority, J. P. Chaplin of New Martinsville, W. Va.

	Top. Feet.
Coal No. 12 (Washington)	82
Coal, Pittsburg	540
Keener sand	1730
Big Injun sand, first oil pay	1828
Second oil pay	1851
Total	1870

The J. A. Kocher core test well (W 281) near this well encountered only 2 feet 10½ inches of coal, according to Alonzo P. Sidell of New Martinsville, W. Va., who was interested and saw the coal measured. The writer saw some of the coal from this test and it appeared slaty and not very pure.

Geo. W. Cook No. 1 Well Record (W 279), Proctor District.

Located ¼ mile east of Maud P. O. Authority, J. P. Chaplin of New Martinsville, W. Va.

	Feet.
Coal No. 12 (Washington)	125
Coal, Pittsburg	585
Cow Run sand	1100
Oil pay in **Big Injun sand**	1880

On the north bank of Little Fishing in the extreme southeast corner of Proctor district and 8-10ths mile above the mouth of Scheidler run, a dry hole was drilled on the Kirkland farm. Its record is as follows:

J. L. Kirkland No. 1 Well Record (W 277), Proctor District.

Authority, Kanawha Oil Co. Top, 755′ A. T.

	Feet.	Feet.
10-inch casing	400	
Pittsburg coal (75′ A T.)	680	
8-inch casing	1140	
Maxton sand	1750	
6⅝-inch casing	1880	
Big Injun sand	1850 to	2075
Gordon Stray sand	2700 to	2720
Gordon sand	2730 to	2742
Total depth		2878

Begun Oct. 30, 1906; completed Dec. 20, 1906

50 barrels of salt water per hr. in the Maxton sand.

No sign of **water, gas** or **oil** in the Big Injun, Stray and Gordon sands.

	Feet.
Top of **Pittsburg coal** to **Maxton sand**	1070
Top of **Pittsburg coal** to **Big Injun sand**	1170
Top of **Pittsburg coal** to **Gordon Stray sand**	2020
Top of **Pittsburg coal** to **Gordon sand**	2050

Several wells have been drilled in the vicinity of West P. O. in eastern Proctor district, but thus far no paying oil or gas wells have been found. The abbreviated record of the Geo. Dunham No. 1 well (W 275), located slightly over one mile and a half S. 15°-25° W. of West P. O., is found

on page 404 in the tabular list of Wetzel county wells. This well also reported 4 feet of coal at a depth of 590 feet, coming 517 feet above the Pittsburg bed. This would represent the Washington bed.

MAGNOLIA DISTRICT.

Magnolia district occupies most of the Ohio river front of Wetzel county and its area is traversed by two structural folds; viz., the New Martinsville anticline and the Loundenville (Finney) syncline. Several dry holes have been drilled north of Fishing creek within its boundary. The records of two have already been published; viz., Ed Wagner No. 1 (W 299) and Samuel Martin No. 1 (W 302) on pages 273 and 99 respectively. The A. Morgan No. 1 well (W 304), located on the south side of Fishing creek, 2¼ miles S. E. of New Martinsville station, is a small gas well in the **Keener** sand. The following is the record of a well located 4-10 mile north of the Morgan well (W 304):

J. C. Wise Well No. 1, Well Record (W 303), Magnolia Dist.

Located 2 miles S. E. of New Martinsville station on neck of peninsula of Fishing creek. Authority, Tri-State Gas Co. Completed Jan. 6, 1908.

	Top. Feet.	Bottom Feet.
Pittsburg coal	453	
Little Dunkard sand	830	850
Big Dunkard sand	970	1000
Gas sand	1070	1100
Gas sand	1150	1200
Salt sand	1240	1280
Slate	1280	1290
Salt sand	1290	1350
Slate	1350	1430
Salt sand	1430	1460
Slate	1460	1530
Lime	1530	1600
Keener sand (show of gas at 1620')	1600	1650
Slate	1650	1690
Big Injun sand	1690	1700
Slate	1700	1710
Sand, shelly	1710	1810
Slate	1810	2500
Shelly sand (Gordon)	2500	2510

	Top. Feet.	Bottom Feet.
Slate	2510	2520
Shelly sand	2520	2530
Slate to bottom	2530	3014

Dry in all sands.

	Feet.
Top of Pittsburg coal to Keener sand	1147
Top of Pittsburg coal to Gordon sand	2047

The rocks rise rapidly from the mouth of Little Fishing creek southwestward to the level of the Elk Fork terrace (see page 71). On Pt. Pleasant creek in southern Magnolia district, (W 307) and (W 310), located on this slope, are light oil wells in the Keener sand.

Z. S. Watkins No. 1 Well Record (W 308), Magnolia Dist.

Located ¼ mile N. W. of Van Camp P. O. Authority, Melrose Oil and Gas Co.

	Top Feet.	Thickness Feet.
Salt sand	1050	50
Matxon sand	1450	
Big lime	1575	65
Keener sand	1675	
Big Injun sand	1690	
Total depth	1726	

TYLER COUNTY WELL RECORDS.

The earliest oil and gas development in the Marshall-Wetzel-Tyler area took place in Tyler county on the opening up of the Sistersville field (See page 359.) in 1891, and since that time the latter county next to Wetzel, has probably produced more oil than any other in the State.

The accompanying table contains the abbreviated records of over 200 wells drilled for oil and gas, as well as the tidal elevations on 60 other similar wells of which the writer did not obtain the record or log. As in the case of Marshall and Wetzel counties, these records have been chosen on account of their wide distribution and in some cases on account of some special feature connected with the well. To the writer's knowledge no diamond drill borings have yet been put down in Tyler county. The wells have also been numbered from 1 up to 260, and grouped entirely by magisterial

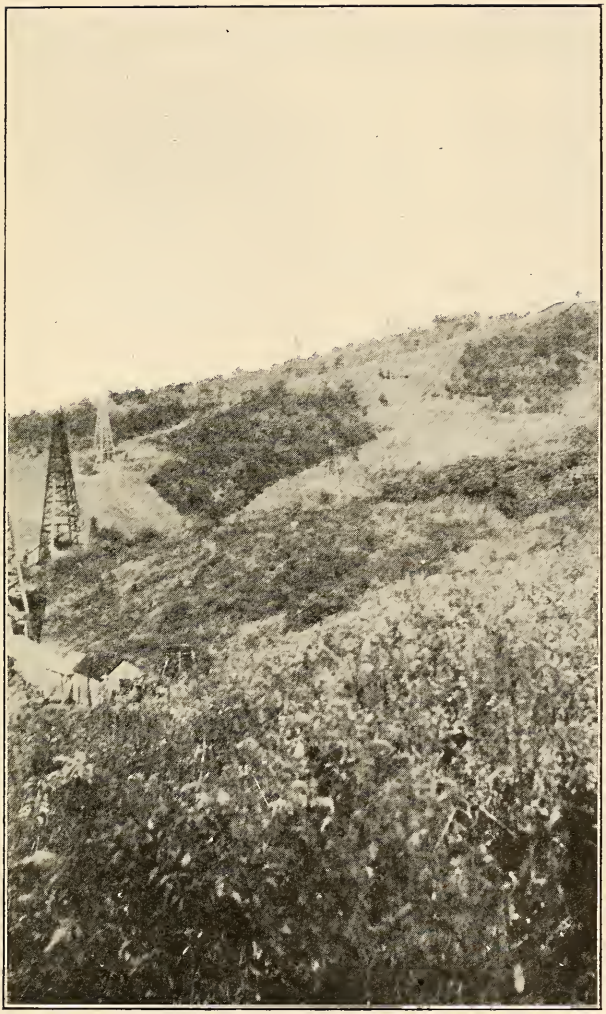

Plate X.—Showing Oil Wells Along Steep Hillsides in the Wick Field of Tyler County.

districts, the serial number in each case corresponding to the number of the same well on the economic geology map accompanying this report in a separte cover (See explanations preceding table of Marshall county wells, page 362).

Under the column headed "Pittsburg Coal," depths and elevations, recorded in parentheses, are those supplied by the writer on the assumption that the horizon of the coal belongs at a varying interval above the top of the Big Injun sand. This interval showed a gradual increase from the Ohio river to the eastern end of the county; e. g., at Sistersville, it is 1180 feet; south of Middlebourne, 1225 feet; and near Big Moses in the eastern part of the county, 1325 feet. Under the same column, where the depth is given without the parenthesis, it denotes the Pittsburg coal was called for in the well record. The blossom of this coal was noted at a few scattered wells over the county, and the intervals given by the latter down to the top of the Big Injun sand were used by the writer in supplying the depths to the Pittsburg bed in well records when the driller had failed to note the coal for that particular locality.

Under the column headed "Owner" in the table of wells for Tyler county, the following abbreviations are used:

A. Leonard	A. Leonard et al.
American	American Oil and Development Co.
Carter	Carter Oil Company.
Centerville	Centerville Oil and Gas Company.
Colonial	Colonial Oil Company.
Crawford	Crawford Oil & Gas Company.
Fisher	The Fisher Oil Company.
Henaghan	Henaghan & Hanlon.
Home Drg. Co.	Home Drilling Company.
Hope	Hope Natural Gas Company.
J. T. Ingram & C.	J. T. Ingram & Company.
Kanawha	Kanawha Oil Company.
Linden O. Co.	Linden Oil Company.

McCoach .....McCoach et al.
McKeever & G.....McKeever & Gailey.
McKelvy Etc. .....McKelvey & Company.
McKelvy O. & G. .....McKelvy Oil & Gas Company.
Melrose .....Melrose Oil & Gas Company.
Murphy & Jen. .....Murphy & Jennings.
Owl Hollow O. .....Owl Hollow Oil Company.
Philadelphia ....Philadelphia Company.
Pure .....Pure Oil Company.
Reno .....Reno Oil Company.
Sparks D. Co.....Sparks Drilling Company.
Spragg O. Co.....Spragg Oil Company.
Southern .....Southern Oil Company.
South Penn .....South Penn Oil Company.
Tri-State .....Tri-State Gas Company.
Tyler O. Co. .....Tyler Oil Company.
W. Sawtelle .....W. Sawtelle et al.

In the elevation column the letter B indicates that the elevation of the top of the hole was obtained by aneroid checked on nearby U. S. G. S. spirit level elevations; the letter L by spirit level measurement. Elevations are expressed in feet above tide.

The accompanying table of wells drilled for oil and gas in Tyler county is very convenient for ready reference, but, as in the case of Marshall and Wetzel counties, it is very important that the complete record of a number of these wells be given, not only to preserve them from loss, but for the great fund of information the complete records contain with reference to other oil and gas horizons than the Big Injun and Gordon sands, as well as the presence or absence of other coals than the Pittsburg bed. The accurate location of any well is readily determined by its serial number published both with the record and on the economic geology map accompanying this report in a separate cover.

Oil and gas have been produced in every district of Tyler county, with Lincoln, Ellsworth, McElroy and Meade taking the lead. The well records and discussion of the vari-

ous fields will now be taken up as in Wetzel and Marshall by magisterial districts:

LINCOLN DISTRICT.

Lincoln district, Tyler county, borders on the Ohio river and adjoins Wetzel county on the northeast. Its area is traversed by two structural folds; viz., the Sistersville anticline and the Shiloh syncline. The major portion of the great Sistersville oil field lies within its boundaries. The oil in this field occurs mostly in the **Big Injun sand** proper, the **Keener sand** producton starting in only near the Lincoln-Union district line and extending southwestward.

The Sistersville field is found both on the crest and a short distance down the slopes of the Sistersville anticline. In this respect it differs from any other field of the Marshall-Wetzel-Tyler area, or, for that matter, in the State. Dr. I. C. White[21] gives the following interesting account of the occurrence of oil, gas, and salt water at the same horizon in this field:

"One peculiarity of the Big Injun Sand region of Sistersville worthy of note is the fact that the oil occurs mixed with vast quantities of both salt water and gas, the three not having been separated in their rock reservoir, as is the rule, so that when the first well was drilled into the sand on Polecat run, near Sistersville, more than a year previous to the completion of the Stewart well, the former failing to produce oil in paying quantity, was abandoned as unproductive. It was discovered by experience that three-inch tubing, instead of two-inch, was required to enable the pump to exhaust the salt water and permit the oil to come into the wells freely. Then, two years after the "Polecat" well had been abandoned as worthless, its owners put the larger tubing into the same, and, after pumping salt water for a month or more, were rewarded by securing a flowing oil well which produced 500 barrels of oil daily, along with probably twice as much salt water. The explanation of this peculiar mixing of the wa-

21. Vol I (a), pp. 238-239, W. Va. Geol. Survey.

Summarized record of

No. on Map	NAME OF WELL	Location—District	Owner	Elevation
1	J. M. Ice No. 1	Lincoln	Tri-State	800B
2	J. S. Buck No. 1	Lincoln	Carter	809L
3	Daniel Davis No. 1	Lincoln	A. Leonard	840L
4	Lloyd Kimble No. 1	Lincoln	Hope	820B
5	T. J. Buck No. 1	Lincoln	Hope	1200L
6	Eliz. Pollock No. 1	Lincoln	McCoach	720B
7	A. C. McCallum No. 1	Lincoln	Owl Hollow O.	755B
8	Russell Hrs. No.	Lincoln	Carter	638L
9	Joshua Russell No. 1	Lincoln	Carter	625B
10	J. B. McCoy No. 12	Lincoln	Reno	685B
11	Jos. Shook No. 6	Lincoln	Carter	1115B
A11	Roome-Iseman No. 8	Lincoln	Carter	.....
12	Henry Roberts No. 1	Lincoln	J. McCoach	813L
13	Dunfield No. 6	Lincoln	Carter	1060B
14	Geo. Stocking No. 1	Lincoln	Carter	1050B
A14	J. T. Leasure No. 3	Lincoln	Carter	1017L
15	Steel Hrs. No. 2	Lincoln	Carter	665B
16	C. P. McCoy No. 3	Lincoln	Carter	810B
17	Geo. Stocking No. 4	Lincoln	Carter	785B
18	N. Salisbury No. 3	Lincoln	Carter	825L
A18	J. B. McCoy No. 15	Lincoln	Carter	785L
19	Chas. Knoke No. 4	Lincoln	Carter	(1000B)
20	Eph. Wells No. 5	Lincoln	Carter	630B
21	Eph. Wells No. 8	Lincoln	Carter	638L
22	F. R. Wells No. 26	Lincoln	Carter	620B
23	Anshutz No. 20	Lincoln	Carter	700B
24	Keener Hrs. No. 2	Lincoln	Carter	825B
25	Dr. J. L. Thistle No. 8	Lincoln	Carter	775B
26	Jno. Clark No. 6	Lincoln	Carter	720B
27	Chas. Mikle No. 1	Lincoln	McKelvy Etc.	885B
28	C. E. Smith No. 1	Lincoln	Unity O. Co.	1165B
29	Geo. F. Fetty No. 1	Lincoln	E. J. McJunkin	850B
30	John W. Kile No. 1	Lincoln	J. T. Jones	685B
31	Gorman Hrs. No. 1	Lincoln	Pure	900B
32	A. Scannahorn No. 1	Lincoln	J. T. Ingram & C.	870B
33	H. J. Carpenter No. 1	Lincoln	J. T. Ingram & C.	810L
A33	G. L. Meredith No. 1	Lincoln	J. T. Ingram & C.	870B
34	A. Heinzman No. 1	Lincoln	Carter	760B
35	J. B. Lazy No. 3	Lincoln	B. D. Greenlee	715B
36	Keener Hrs. No. 30	Union	Carter	1005B
37	Sarah A. Holmes No. 5	Union	Carter	1080B
38	W. F. Holmes No. 8	Union	Carter	1035B
39	Anshutz No. 12	Union	Carter	649L
40	J. A. Davenport No. 10	Union	Carter	620B
41	Wm. Hays No. 1	Union	Fisher et al.	630B
42	Jane Williamson No. 1	Union	Zahnizer & Co.	628L
43	Adam Williamson No. 6 or 7	Union	Ihrig et al.	625B
44	W. A. Beagle No. 1	Union	Carter	720B
45	Milroy Ralnig No. 1	Union	Lauffer Bros.	980B

Wells in Tyler County.

PITTSBURG COAL			BIG INJUN SAND		GORDON SAND		Total Depth	Producing Sand	No. on Map
Depth (top)	Elevat'n (top)	Thick-ness	Depth (top)	Thick-ness	Depth (top)	Thick-ness			
(430)	(370)	.....	1606	.....	.....	.....	.....	Keener	1
(448)	(361)	.....	1628	.....	.....	.....	1644	Keener	2
(500)	(340)	.....	1682	.....	.....	.....	1746	Keener	3
.....	.....	.....	.....	.....	.....	.....	.....	Keener	4
.....	.....	.....	.....	.....	.....	.....	.....	Keener	5
.....	.....	.....	.....	.....	.....	.....	.....	Keener	6
(355)	(400)	.....	1535	102	.....	.....	.....	Big Injun	7
.....	.....	.....	.....	.....	.....	.....	.....	Big Injun	8
(200)	(425)	.....	1379	.....	.....	.....	1493	Big Injun	9
(250)	(435)	.....	1430	.....	.....	.....	1500	Big Injun	10
(745)	(370)	.....	1925	.....	.....	.....	1982	Big Injun	11
670	.....	6	1850	121	.....	.....	1971	Big Injun	A11
.....	.....	.....	.....	.....	.....	.....	.....	Big Injun	12
(640)	(420)	.....	1822	.....	.....	.....	1829	Big Injun	13
(640)	(410)	.....	1818	.....	.....	.....	1862	Big Injun	14
568	449	4	1743	118	.....	.....	1861	Big Injun	A14
(230)	(435)	.....	1410	.....	.....	.....	1452	Big Injun	15
(367)	(443)	.....	1547	.....	.....	.....	.....	Big Injun	16
(345)	(440)	.....	1527	.....	.....	.....	1571	Big Injun	17
(415)	(410)	.....	1595	.....	.....	.....	1656	Big Injun	18
(335)	(450)	.....	1517	118	.....	.....	1635	Big Injun	A18
(600)	(400)	.....	1783	.....	.....	.....	1832	Big Injun	19
(215)	(415)	.....	1394	.....	.....	.....	1447	Big Injun	20
(215)	(423)	.....	1395	.....	.....	.....	1427	Big Injun	21
(185)	(435)	.....	1365	.....	.....	.....	1414	Big Injun	22
(260)	(440)	.....	1440	75	.....	.....	1515	Big Injun	23
375	450	.....	1557	.....	.....	.....	1658	Big Injun	24
410	365	6	1568	.....	.....	.....	1620	Keener	25
(380)	(340)	.....	1597	.....	.....	.....	1655	Big Injun	26
.....	.....	.....	.....	.....	.....	.....	.....	....	27
.....	.....	.....	.....	.....	.....	.....	.....	....	28
.....	.....	.....	.....	.....	.....	.....	.....	....	29
.....	.....	.....	.....	.....	.....	.....	.....	....	30
(530)	(370)	.....	1716	.....	.....	.....	1744	Keener	31
(500)	(370)	.....	1685	.....	.....	.....	1698	Keener	32
(470)	(340)	.....	1655	.....	.....	.....	1680	Keener	33
(515)	(355)	.....	1700	.....	.....	.....	1720	Keener	A33
470	290	.....	1669	100	.....	.....	1747	....	34
.....	.....	.....	.....	.....	.....	.....	.....	Keener	35
(570)	(435)	.....	1751	.....	.....	.....	1819	Keener	36
(660)	(420)	.....	1840	.....	.....	.....	1950	Big Injun	37
(595)	(440)	.....	1745	.....	.....	.....	1900	Big Injun	38
218	431	4	1368	151	.....	.....	1519	Big Injun	39
(200)	(420)	.....	1380	.....	.....	.....	1423	Big Injun	40
(165)	(465)	.....	1325	.....	.....	.....	.....	Keener	41
(170)	(450)	.....	1329	.....	.....	.....	.....	Keener	42
160	465	7	1340	.....	.....	.....	.....	Big Injun	43
(375)	(345)	.....	1565	110	.....	.....	1684	....	44
.....	.....	.....	.....	.....	.....	.....	.....	....	45

Summarized record of

No. on Map	NAME OF WELL	Location—District	Owner	Elevation
46	Jesse White No. 2	Union	Melrose	640B
47	Thos. Moore No. 4	Union	Crawford	670B
48	Thos. Moore No. 6	Union	Crawford	623L
49	Thos. Moore core test	Union	(Geo. Brown)	625L
50	J. S. Wells No. 1	Union	Schleigel & Fried..	626L
51	J. S. Wells No. 12	Union	Schleigel & Fried..	625L
52	J. S. Wells core test	Union	Geo. Brown	625B
53	R. C. Massey No. 1	Union	Henaghan	799L
54	R. C. Massey No. 8	Union	Henaghan	840L
55	J. & M. Hissam No. 2	Union	Tyler O. Co.	1007L
56	Frank Fonner No. 9	Union	Treat & Crawford..	775B
57	A. & H. C. Williams No. 5	Union	McJunkin	855B
58	A. & H. C. Williams No. 1	Union	McJunkin	785B
59	David Danser No. 1	Union	McKelvy & Co.	773L
60	Harriet E. Stokes No. 1	Union	Home Drg. Co.	665B
61	E. J. Osborn No. 1	Union	Ivy Oil Co.	665B
62	Jno. Lady No. 2	Union	McCutchen Bros.	650L
63	J. B. Danser No. 1	Union	D. A. Bartlett	655L
64	W. M. Keller No. 3	Union	D. A. Bartlett	646L
65	Addie Knowlton No. 1	Union	J. T. Jones	835B
66	Jos. Archer No. 2	Union	J. T. Jones	655B
67	Jos. Archer No. 1	Union	J. T. Jones	665B
68	Jos. Archer No. 1	Union	McKeever & G.	(630B)
69	Jos. Archer No. 6	Union	J. T. Jones	685B
70	Christian Hrs. No. 3	Ellsworth..	Southern	720B
71	T. B. Watkins No. 7	Ellsworth..	Southern	708L
72	T. B. Watkins No. 7	Ellsworth..	McKelvey O. & G..	711L
73	R. A. Myers No. 2	Ellsworth..	South Penn.	805B
74	N. C. Fluharty No. 3	Ellsworth..	South Penn.	900B
75	Jno. Fulmer No. 1	Ellsworth..	South Penn.	1190B
76	M. A. Gorrell No. 6	Ellsworth..	South Penn.	1298L
77	Beatty Hrs. No. 4	Ellsworth..	Carter	895B
78	J. T. Farrell No. 1	Ellsworth..	Carter	805B
79	Sarah McCormick No. 1	Ellsworth..	Carter	850B
80	Harrison Asher No. 9	Ellsworth..	South Penn.	730B
81	Wm. Farrell No. 3	Ellsworth..	South Penn.	791L
82	Schoolhouse lot No. 1	Ellsworth..	Carter	720B
83	J. L. Wood No. 1	Ellsworth..	Carter	715B
84	Catharine Fulmer	Ellsworth..	Carter	875B
85	Naomi (Levi) Ankrom No. 1	Ellsworth..	Carter	730B
86	A. B. Ankrom No. 1	Ellsworth..	Melrose	707L
87	Elias Haught No. 1	Ellsworth..	Melrose	765B
88	Wm. T. Lazier No. 7	Ellsworth..	Melrose	740B
89	Wm. T. Lazier No. 6	Ellsworth..	Melrose	760B
90	Wm. T. Lazier No. 3	Ellsworth..	Melrose	785B
91	O. P. Stealey No. 9	Ellsworth..	Melrose	990B
92	A. L. Stackpole No. 3	Ellsworth..	South Penn.	1030B
93	Jno. Thomas No. 1	Ellsworth..	Benedum & Trees..	1059L
94	M. H. Stealey No. 1	Ellsworth..	South Penn.	680B

Wells in Tyler County, (continued).

PITTSBURG COAL			BIG INJUN SAND		GORDON SAND		Total Depth	Producing Sand	No. on Map
Depth (top)	Elevat'n (top)	Thick-ness	Depth (top)	Thick-ness	Depth (top)	Thick-ness			
165	475	.....	1345	.....	.....	.....	1420	Keener	46
(210)	(460)	.....	1390	.....	.....	.....	.....	Keener	47
.....	.....	.....	.....	.....	.....	.....	.....	Keener	48
175	450	3.5	.....	.....	.....	.....	180?	....	49
(145)	(481)	.....	1347	.....	.....	.....	.....	Maxton and Keener	50
.....	.....	.....	.....	.....	.....	.....	.....	Keener	51
.....	.....	.....	.....	.....	.....	.....	.....	....	52
(400)	(399)	.....	.....	.....	.....	.....	760	I. Cow Run	53
(440)	(400)	.....	.....	.....	.....	.....	794	I. Cow Run	54
.....	.....	.....	.....	.....	.....	.....	.....	I. Cow Run	55
.....	.....	.....	.....	.....	.....	.....	.....	I. Cow Run	56
.....	.....	.....	.....	.....	.....	.....	.....	I. Cow Run	57
.....	.....	.....	.....	.....	.....	.....	.....	I. Cow Run	58
.....	.....	.....	.....	.....	.....	.....	.....	....	59
.....	.....	.....	.....	.....	.....	.....	.....	....	60
350	315	5	1540	.....	.....	.....	1600	Big Injun	61
(327)	(323)	.....	1517	.....	.....	.....	.....	Keener	62
(285)	(370)	.....	1478	.....	.....	.....	.....	Keener	63
(256)	(390)	.....	1463	.....	.....	.....	.....	Keener	64
.....	.....	.....	.....	.....	.....	.....	1273	Salt	65
(300)	(355)	.....	1500	.....	.....	.....	1515	Big Injun	66
(330)	(335)	.....	1510	.....	.....	.....	1547	Big Injun	67
.....	.....	.....	.....	.....	.....	.....	.....	Big Injun	68
(340)	(345)	.....	1519	.....	.....	.....	1544	Big Injun	69
(400)	(320)	.....	1600	.....	.....	.....	.....	Keener	70
.....	.....	.....	.....	.....	.....	.....	.....	Keener	71
(388)	(323)	.....	1588	.....	.....	.....	.....	Keener	72
(487)	(318)	.....	1687	.....	.....	.....	1728	Keener	73
(600)	(300)	.....	1802	.....	.....	.....	1847	Keener	74
(860)	(330)	.....	2072	.....	.....	.....	.....	Keener	75
(960)	(338)	.....	(2170)	.....	.....	.....	2232	Keener	76
.....	.....	.....	1839	.....	.....	.....	1865	Keener	77
.....	.....	.....	1784	.....	.....	.....	1851	Big Injun	78
.....	.....	.....	1825	.....	.....	.....	1943	....	79
(440)	(290)	.....	1650	.....	.....	.....	1683	Keener	80
(485)	(306)	.....	1693	.....	.....	.....	1724	Keener	81
.....	.....	.....	.....	.....	.....	.....	.....	Keener	82
.....	.....	.....	.....	.....	.....	.....	1635	Keener	83
.....	.....	.....	1759	.....	.....	.....	1839	Keener	84
(425)	(305)	1625	.....	.....	.....	.....	.....	Big Injun	85
(400)	(307)	.....	1606	.....	.....	.....	1639	Keener	86
.....	.....	.....	1635	.....	.....	.....	1705	Big Injun	87
(420)	(320)	.....	1627	.....	.....	.....	.....	Big Injun	88
(440)	(320)	.....	1646	.....	.....	.....	1700	Big Injun	89
(485)	(300)	.....	(1690)	.....	.....	.....	1730	Dawson	90
(665)	(325)	.....	1870	.....	.....	.....	1920	Big Injun	91
(705)	(325)	.....	1908	.....	.....	.....	1931	Keener	92
.....	.....	.....	.....	.....	.....	.....	1996	....	93
(370)	(310)	.....	1604	.....	.....	.....	1619	Dawson and Keener.....	94

Summarized record of

No. on Map	NAME OF WELL	Location—District	Owner	Elevation
95	J. G King No. 5	Ellsworth..	South Penn.	(——)
96	J. G. King No. 2	Ellsworth..	South Penn.	(——)
97	John King No. 2	Ellsworth..	South Penn.	853L
98	D. & B. Bennett No. 1	Ellsworth..	C. W. Mercer	(770B)
99	Israel Folger No. 3	Ellsworth..	South Penn.	(——)
100	David Hickman No. 1	Ellsworth..	South Penn.	790B
101	J. S. Ankrom No. 1	Ellsworth..	South Penn.	735B
102	W. W. Allen No. 1	Ellsworth..	Pure	860B
103	K. S. Boreman No. 2	Ellsworth..	McCutch. Bros.	.....
104	Mary Jemison No. 3	Ellsworth..	Octave Oil Co.	.....
105	J. R. Malloy No. 1	Ellsworth..	South Penn.	686L
106	J. G. Gorrell No. 3	Ellsworth..	Melrose	741L
107	J. G. Gorrell No. 4	Ellsworth..	Melrose	682L
108	A. A. Haught No. 1	Ellsworth..	Melrose	782L
109	L. M. Thomas (No. 2 ?)	Ellsworth..	American	885B
110	Pierpont Est. No. 1	Ellsworth..	Melrose	925B
111	J. R. Baker No. 1	Ellsworth..	Carter	690B
112	Mary E. Johnson No. 1	Ellsworth..	Carter	710B
113	Wm. Morris No. 1	Ellsworth..	American	.....
114	J. & E. Mason No. 6	Ellsworth..	South Penn.	840B
115	F. L. Rymer No. 1	Ellsworth..	South Penn.	680B
116	F. L. Rymer No. 7	Ellsworth..	South Penn.	780B
117	Samuel Attleberger No. 3	Ellsworth..	South Penn.	750B
118	J. W. Cummins No. 1	Ellsworth..	South Penn.	710B
119	David F. Smith No. 1	Ellsworth..	Melrose	(——)
120	Isaiah Baker No. 5	Ellsworth..	South Penn.	(——)
121	Isaiah Baker No. 7	Ellsworth..	South Penn.	898L
122	Isaiah Baker No. 3	Ellsworth..	South Penn.	815L
123	Isaiah Baker No. 2	Ellsworth..	South Penn.	795L
124	Anderson Stealey No. 1	Ellsworth..	South Penn.	(——)
125	Eliza Lemasters No. 1	Ellsworth..	Kanawha	888L
126	J. M. Mayfield No. 2	Ellsworth..	South Penn.	832L
127	W. E. Mayfield No. 1	Ellsworth..	Spragg O. Co.	830L
128	Albert Kinney No. 1	Ellsworth..	South Penn.	813B
129	Elias Stewart No. 1	Ellsworth..	Linden O. Co.	860B
130	Jacob Clark No. 1	Ellsworth..	South Penn.	809L
131	Boreman & Straus No. 8	Ellsworth..	South Penn.	(——)
132	Rebecca Hays No. 1	Ellsworth..	Henry Oil Co.	765B
133	Jonathan Ankrom No. 2	McElroy ...	Philadelphia	705L
134	Absalom Thomas No. 4	McElroy ...	Philadelphia	701L
135	M. W. Spencer No. 1	McElroy ...	Philadelphia	716L
136	John Tustin Hrs. No. 1	McElroy ...	Tri State	744L
137	W. W. Myers No. 1	McElroy ...	Tri State	800B
138	Jas. F. Powell No. 1	McElroy ...	Tri State	865B
139	Samuel Woodburn No. 1	McElroy ...	Carter	855B
140	Elizabeth Stoneking No. 1	McElroy ...	Tri State	794L
141	Noah Booker No. 1	McElroy ...	Carter	750B
142	C. J. Allen No. 1	McElroy ...	American	(——)
143	C. J. Allen No. 2	McElroy ...	American	(——)

Wells in Tyler County, (continued).

PITTSBURG COAL			BIG INJUN SAND		GORDON SAND		Total Depth	Producing Sand	No. on Map
Depth (top)	Elevat'n (top)	Thick-ness	Depth (top)	Thick-ness	Depth (top)	Thick-ness			
.....	.....	.....	.....	.....	.....	.....	.....	Dawson	95
.....	.....	.....	1938	.....	.....	.....	1973	Dawson and Keener	96
(535)	(318)	.....	1769	.....	.....	.....	1800	Keener	97
(450)	(320)	.....	(1685)	.....	.....	.....	1644	Dawson	98
.....	.....	.....	2159	178	3021	3	3840	....	99
(475)	(315)	.....	1698	.....	2708	.....	2875	....	100
.....	.....	.....	.....	.....	.....	.....	.....	....	101
.....	.....	.....	1877	103	.....	.....	1980	Big Injun	102
.....	.....	.....	1749	109	.....	.....	1858	....	103
.....	.....	.....	1797	.....	.....	.....	1882	....	104
(370)	(316)	.....	.....	.....	.....	.....	1500?	Maxton	105
.....	.....	.....	.....	.....	.....	.....	1516	Dawson	106
(330)	(352)	.....	1548	.....	.....	.....	1643	Dawson	107
.....	.....	.....	.....	.....	.....	.....	1583	Dawson	108
.....	.....	.....	.....	.....	.....	.....	.....	Big Injun	109
(535)	(390)	.....	1758	.....	.....	.....	1872	Maxton	110
400	290	3	1625	165	.....	.....	1812	....	111
(390)	(320)	.....	1615	176	.....	.....	1881	....	112
520	.....	.....	1784	.....	.....	.....	1880	....	113
.....	.....	.....	.....	.....	.....	.....	.....	Maxton	114
417	263	.....	1708	.....	.....	.....	1726	Keener	115
.....	.....	.....	1760	.....	.....	.....	1771	Keener	116
.....	.....	.....	1713	.....	.....	.....	1810	Maxton and Keener	117
.....	.....	.....	.....	.....	.....	.....	.....	....	118
860?	.....	.....	1990	.....	.....	.....	2105	Keener	119
682	.....	6	1927	143	.....	.....	2080	....	120
566	332	0	1830	.....	.....	.....	1847	Big Injun	121
(482)	(333)	0	1746	.....	.....	.....	3840	Maxton and Big Injun	122
470	325	6	1734	.....	.....	.....	.....	Big Injun	123
695	.....	3	1989	65	2764	2	2875	Gordon	124
.....	.....	.....	.....	.....	.....	.....	.....	....	125
473	359	4	1823	.....	.....	.....	1890	Big Injun	126
.....	.....	.....	.....	.....	.....	.....	.....	Big Injun	127
483	330	.....	1760	.....	.....	.....	1860	Big Injun	128
.....	.....	.....	.....	.....	.....	.....	.....	....	129
.....	.....	.....	1780	.....	.....	.....	1850	Big Injun	130
.....	.....	.....	2059	.....	.....	.....	2184	....	131
.....	.....	.....	.....	.....	.....	.....	2600?	....	132
.....	.....	.....	.....	.....	.....	.....	.....	....	133
.....	.....	.....	.....	.....	.....	.....	.....	....	134
370	346	2	1705	170	2445	.....	2480	Gordon	135
.....	.....	.....	.....	.....	.....	.....	.....	....	136
455	345	1	1750	225	2535	.....	2590	Gordon	137
.....	.....	.....	.....	.....	.....	.....	.....	....	138
530	325	4	1836	.....	2591	8	2650	Maxton?	139
460	334	3	1775	.....	.....	.....	1840	Big Injun	140
(385)	(365)	.....	1702	167	.....	.....	1869	Big Injun	141
760	.....	.....	.....	.....	.....	.....	1958	Maxton	142
790	.....	.....	.....	.....	.....	.....	1968	Maxton	143

Summarized record of

No. on Map	NAME OF WELL	Location—District	Owner	Elevation
144	Smith & Furbee No. 1	McElroy	Philadelphia	1170B
145	John Groves No. 1	McElroy	Philadelphia	955B
146	Groves Heirs No. 1	McElroy	American	810B
147	Lloyd Weekly No. 1	McElroy	American	(——)
148	Moses Spencer No. 1	McElroy	American	720B
149	Moses Spencer No. 2232	McElroy	Philadelphia	765B
150	Pres. M. Furbee No. 1	McElroy	South Penn.	776L
151	Pres. M. Furbee No. 1	McElroy	American	719L
152	Jno. Seekman No. 1	McElroy	American	723L
153	D. N. Furbee & Bros. No. 4	McElroy	American	852L
154	Zane Underwood No. 2	McElroy	Philadelphia	(750B)
155	B. F. Reed No. 1, No. 1744	McElroy	Philadelphia	726L
156	J. M. Smith No. 1	McElroy	South Penn.	775B
157	J. L. Ash No. 1	McElroy	Carter	930B
158	W. W. Pratt No. 1	McElroy	South Penn.	853L
159	Ed Cain No. 1	McElroy	Carter	785B
160	Wm. Sandy No. 1	McElroy	South Penn.	1160B
161	Wm. Sandy No. 2	McElroy	South Penn.	920B
162	Sol. Underwood No. 1	McElroy	South Penn.	761L
163	Underwood & Orr No. 3	McElroy	South Penn.	(——)
164	Mary Smith No. 1	McElroy	Hope	726L
165	Asa Underwood No. 1	McElroy	Hope	(——)
166	Silas Underwood No. 1	McElroy	South Penn.	780B
167	David Underwood No. 19	McElroy	South Penn.	765B
168	Ralph Sweeney No. 7	McElroy	South Penn.	742L
169	Ralph Sweeney No. 8	McElroy	South Penn.	747L
170	Silas Langfitt No. 9	McElroy	South Penn.	740B
171	David Underwood No. 20	McElroy	South Penn.	(——)
172	David Underwood No. 12	McElroy	South Penn.	783B
173	Ida B. Ash No. 1	McElroy	South Penn.	(——)
174	W. McCormick No. 10	McElroy	South Penn.	785b
175	W. McCormick No. 12	McElroy	South Penn.	784L
176	Steven Allen No. 1	McElroy	Colonial	785B
177	Jas. Thomas No. 1	McElroy	Philadelphia	785B
178	E. Lemasters No. 1	McElroy	Philadelphia	845B
179	G. W. Headley No. 1	McElroy	South Penn.	1205B
180	Alpheus Glover No. 4	McElroy	South Penn.	1020B
181	Thompson Heirs No. 2	McElroy	South Penn.	836L
182	Thompson Heirs No. 1	McElroy	South Penn.	869L
183	Silas Wyatt No. 4	McElroy	South Penn.	810L
184	J. L. McIntire No. 1	McElroy	South Penn.	825B
185	J. Q. McIntire No. 7	McElroy	South Penn.	848L
186	F. R. Ball No. 15	McElroy	South Penn.	837L
187	A. Wharton No. 1	McElroy	South Penn.	860B
188	Susan Glover No. 2	McElroy	South Penn.	(910B)
189	Jas. A. Meredith No. 1	Centerville	South Penn.	1185B
190	Jas. A. Meredith No. 3	Centerville	South Penn.	1185B
191	J. P. Mason No. 1	Centerville	Melrose	814L
192	Jas. Mason No. 1	Centerville	Carter	855B

Wells in Tyler County, (continued).

PITTSBURG COAL			BIG INJUN SAND		GORDON SAND		Total Depth	Producing Sand	No. on Map
Depth (top)	Elevat'n (top)	Thick-ness	Depth (top)	Thick-ness	Depth (top)	Thick-ness			
807	363	3	2140	160	2870	14	2900	Big Injun and Gordon	144
579	376	.....	1916	160	2645	17	2954	Big Injun and Gordon	145
700?	.....	.....	1803	.....	2537	13	2564	Big Injun	146
.....	.....	.....	1715	.....	.....	.....	1777	Big Injun	147
.....	.....	.....	1710	.....	.....	.....	.....	Big Injun	148
432	333	2	1757	175	2502	16	3037	Big Injun	149
.....	.....	.....	1762	.....	.....	.....	1873	Big Injun	150
.....	.....	.....	1696	.....	.....	.....	1795	Big Injun	151
.....	.....	.....	1697	.....	.....	.....	.....	Big Injun	152
520	332	.....	1834	.....	2568	..14	2618½	Gordon	153
490	(260)	4	1819	171	2543	.....	2580	Big Injun	154
.....	.....	.....	.....	.....	.....	.....	.....	Big Injun	155
.....	.....	.....	.....	.....	.....	.....	.....	....	156
.....	.....	.....	1854	86	.....	.....	1972	Big Injun	157
430	423	.....	.....	.....	.....	.....	.....	Big Injun	158
.....	.....	.....	1695	.....	.....	.....	2479	Big Injun	159
798	362	.....	2131	215	2876	20	3005	Big Injun	160
550	370	.....	1880	.....	.....	.....	2003	Big Injun	161
407	354	.....	1732	.....	.....	.....	1876	....	162
761	.....	2	.....	.....	.....	.....	1254	....	163
.....	.....	.....	.....	.....	.....	.....	.....	Big Injun	164
.....	.....	.....	.....	.....	.....	.....	.....	....	165
(490)	(290)	0	1822	.....	.....	.....	1845	Big Injun	166
470	295	.....	1763	233	2530	.....	2605	Big Injun and Gordon	167
450	292	.....	1787	.....	.....	.....	.....	Big Injun	168
450	297	1780	.....	.....	.....	.....	1880	Big Injun	169
470	270	.....	1790	.....	.....	.....	1886	Big Injun	170
605	.....	5	1924	.....	.....	.....	2041	Big Injun	171
495	288	.....	1824	.....	.....	.....	1923	Big Injun	172
935	.....	.....	2257	.....	.....	.....	2369	Big Injun	173
550	235	.....	1850	.....	.....	.....	1952	Big Injun	174
530	254	.....	1786	.....	.....	.....	1918	Big Injun	175
.....	.....	.....	.....	.....	.....	.....	.....	Big Injun	176
.....	.....	.....	.....	.....	.....	.....	.....	Big Injun	177
.....	.....	.....	.....	.....	.....	.....	.....	Gordon Stray	178
949	256	.....	2265	.....	.....	.....	2368	Big Injun	179
815	205	.....	2080	130	2855	21	2900	Gordon	180
632	204	.....	1937	163	2702	17	2727	Gordon	181
665	204	.....	2015	165	2751	9	2782	Gordon	182
595	215	.....	1920	140	2665	15	2685	Gordon	183
624	201	.....	1945	.....	2692	18	2716	Gordon	184
644	204	.....	1964	122	2703	34	2747	Gordon	185
645	192	.....	1965	145	2701	14	2730	Gordon	186
652	208	.....	1962	178	2708	25	2753	Big Injun and Gordon	187
675	(235)	.....	2010	170	2742	20	2765	Gordon	188
.....	.....	.....	2141	.....	.....	.....	2198	Big Injun	189
.....	.....	.....	.....	.....	.....	.....	.....	....	190
(530)	(284)	.....	1780	155	.....	.....	1949	Keener gas	191
.....	.....	.....	.....	.....	.....	.....	.....	....	192

Summarized record of

No. on Map	NAME OF WELL	Location—District	Owner	Elevation
193	S. C. Wilcox No. 2	Centerville.	Carter	810L
194	Caleb Riggs No. 1	Centerville.	Carter	775L
195	A. W. Duty No. 3	Centerville.	Carter	749L
196	A. L. Corbly No. 5	Centerville.	Carter	817L
197	J. L. Anderson No. 1	Centerville.	.....	(740B)
198	Jno. Mercer No. 1	Centerville.	South Penn.	770B
199	David W. Hess No. 1	Centerville.	Centerville	850B
200	Alf. Conaway No. 1	Centerville.	Trainer et al	885B
201	L. D. Cain No. 1	Centerville.	Murphy & Jen	840B
202	Finley Dotson No. 1	Centerville.	Carter	770B
203	Jacob S. Hamilton	Centerville.	C. G. Carter	885L
204	B. L. Pyle No. 1	Centerville.	South Penn.	795L
205	H. G. Grim No. 1	Centerville.	W. Sawtelle	765B
206	C. Z. Freeland No. 1	Meade	Fisher	755L
207	John Loneburger No. 1	Meade	Carter	734B
208	Mary Ash No. 1	Meade	Carter	730B
209	U. T. Freeland No. 10	Meade	Carter	920B
210	Jas. Ash No. 1	Meade	Carter	750B
211	W. R. Gorrell No. 1	Meade	Carter	805L
212	J. J. Gorrell No. 1	Meade	Carter	865B
213	D. D. C. Smith No. 1	Meade	Reno	935B
214	W. I. Robinson No. 1	Meade	J. T. Ingram & C...	870L
215	Sarah E. Wilson No. 1	Meade	Carter	885B
216	E. C. Freeland No. 1	Meade	Carter	825B
217	John Loneburger No. 5	Meade	Carter	775B
218	Eli Long No. 13	Meade	Carter	820L
219	E. B. Long No. 9	Meade	Carter	809L
220	E. B. Long No. 8	Meade	Carter	887L
221	Chas. Eberhart No. 4	Meade	Carter	806L
222	Carse Heirs No. 6	Meade	Carter	907L
223	W. I. Robinson No. 4	Meade	Carter	765L
224	W. T. Masters No. 1	Meade	Carter	775L
225	Jerry Bullman No. 2	Meade	Carter	805B
226	J. W. Ankrom No. 6	Meade	Carter	938L
227	A. J. Ankrom No. 1	Meade	Carter	1025B
228	Emma Masters No. 1	Meade	Carter	1096L
229	Moses Johnson No. 1	Meade	Carter	1082L
230	J. L. Poe No. 16	Meade	Carter	1014L
231	O. W. O. Hardman No. 2	Meade	Carter	1030B
232	J. L. Poe No. 1	Meade	Carter	905B
233	J. L. Poe No. 6	Meade	Carter	(——)
234	J. L. Poe No. 3	Meade	Carter	895B
235	Lycurgus Hill No. 1	Meade	Smith & Trees	821L
236	H. D. Owens No. 3	Meade	Carter	920B
237	Jno. C. Musgrave No. 1	Meade	Carter	1008L
238	Cyrus Bradford No. 1	Meade	Carter	962L
239	A. Broadwater No. 45	Meade	Carter	804L
240	A. Broadwater No. 48	Meade	Carter	815B
241	W. W. Joseph No. 2	Meade	Carter	832L

Wells in Tyler County, (continued).

PITTSBURG COAL			BIG INJUN SAND		GORDON SAND		Total Depth	Producing Sand	No. on Map
Depth (top)	Elevat'n. (top)	Thick-ness	Depth (top)	Thick-ness	Depth (top)	Thick-ness			
(500)	(310)	.....	1760	125	.....	.....	1885	Keener	193
.....	.....	.....	1772	.....	.....	.....	.....	....	194
.....	.....	.....	1737	.....	.....	.....	1854	Big Injun	195
(500)	(317)	.....	1757	.....	.....	.....	1838	Keener	196
.....	.....	.....	.....	.....	.....	.....	(3300)	....	197
400	370	.....	1686	.....	.....	.....	1841	Big Injun	198
(485)	(365)	.....	.....	.....	.....	.....	1740	Big Injun	199
.....	.....	.....	.....	.....	.....	.....	.....	....	200
.....	.....	.....	.....	.....	.....	.....	.....	....	201
393	377	1	1698	217	.....	.....	1888	....	202
.....	.....	.....	.....	.....	.....	.....	.....	Big Injun	203
(484)	(311)	.....	1734	.....	.....	.....	.....	Salt and Big Injun	204
.....	.....	.....	.....	.....	.....	.....	.....	....	205
(455)	(300)	.....	1690	.....	.....	.....	1731	Big Injun	206
(444)	(290)	.....	1680	.....	.....	.....	1765	....	207
.....	.....	.....	1700	.....	.....	.....	1891	....	208
.....	.....	.....	.....	.....	.....	.....	.....	Maxton	209
380	370	0.5	1630	.....	.....	.....	1675	Big Injun	210
400	405	3	1660	.....	.....	.....	1821	Maxton gas	211
450	415	3	1763	.....	.....	.....	1863	....	212
.....	.....	.....	.....	1882	78	.....	1950	Maxton	213
.....	.....	.....	.....	.....	.....	.....	.....	....	214
540	345	6	1760	.....	.....	.....	1864	....	215
.....	.....	.....	1736	154	.....	.....	1890	Big Injun	216
.....	.....	.....	1656	138	.....	.....	1794	Big Injun	217
(460)	(360)	.....	1695	.....	.....	.....	.....	Big Injun	218
(450)	(359)	.....	1685	161	.....	.....	1846	Big Injun	219
575	312	5	1811	.....	.....	.....	1887	Big Injun	220
(425)	(381)	.....	1660	.....	.....	.....	1765	Big Injun	221
.....	.....	.....	1820	85	.....	.....	1960	Big Injun	222
.....	.....	.....	.....	.....	.....	.....	.....	Big Injun	223
.....	.....	0	1675	.....	.....	.....	1804	....	224
.....	.....	.....	1671	157	.....	.....	1833	Big Injun	225
.....	.....	.....	1835	.....	.....	.....	1887	Keener and Big Injun	226
.....	.....	.....	1945	145	.....	.....	2104	....	227
.....	.....	.....	2008	128	.....	.....	2100	Big Injun	228
759	323	1	1976	.....	.....	.....	2101	Big Injun	229
.....	.....	0	1964	.....	.....	.....	2010	Big Injun	230
(720)	(310)	.....	.....	.....	.....	.....	1100	I. Cow Run	231
.....	.....	.....	1825	78	.....	.....	1903	Big Injun	232
.....	.....	.....	.....	.....	.....	.....	1081	I. Cow Run	233
.....	.....	.....	1809	.....	.....	.....	1944	Big Injun	234
.....	.....	.....	.....	.....	.....	.....	.....	....	235
(620)	(300)	.....	.....	.....	.....	.....	992	I. Cow Run	236
(700)	(308)	.....	1938	.....	.....	.....	1990	Big Injun	237
(672)	(290)	.....	1910	.....	.....	.....	2030	Big Injun	238
(510)	(296)	.....	1760	100	.....	.....	1880	Big Injun gas	239
.....	.....	.....	.....	.....	.....	.....	912	....	240
.....	.....	.....	.....	.....	.....	.....	.....	....	241

Summarized record of

No. on Map	NAME OF WELL	Location—District	Owner	Elevation
242	Peter Stewart No. 1	Clay	Carter	992L
243	A. Broadwater No. 47	Meade	Carter	790B
244	J. Sanford Riggs No. 2	Meade	Carter	800L
245	E. Chatter No. 3 or 4	Meade	South Penn.	820B
246	C. T. Livingston No. 3	Meade	Carter	820B
247	Catherine Jones No. 6	Meade	South Penn.	760B
248	B. W. Defibaugh No. 1	LaFayette	American	855L
249	J. D. Livingston No. 13	Meade	Carter	800B
250	M. Alkire No. 1	Meade	Sparks Dr'g Co.	740B
251	Silas Henderson No. 13	Meade	South Penn.	759L
252	Trad Garrison No. 1	Meade	South Penn.	820B
253	B. F. Robinson No. 1	Meade	Carter	895B
254	B. F. Robinson No. 2	Meade	Carter	1020B
255	J. S. Wilson Est. No. 2	Meade	Carter	909L
256	J. S. Wilson Est. No. 1	Meade	Carter	920L
257	Clark Smith No. 5	Meade	Carter	905B
258	Clark Smith No. 1	Meade	Carter	663L
259	Clark Smith No. 2	Meade	Carter	676L
260	M. T .Smith No. 1	Meade	Carter	640B

Wells in Tyler County, (continued).

PITTSBURG COAL			BIG INJUN SAND		GORDON SAND		Total Depth	Producing Sand	No. on Map
Depth (top)	Elavat'n (top)	Thick-ness	Depth (top)	Thick-ness	Depth (top)	Thick-ness			
(650)	(342)	.....	1905	135	.....	.....	2099	Big Injun	242
(490)	(300)	.....	.....	.....	.....	.....	850	I. Cow Run	243
(480)	(320)	.....	.....	.....	.....	.....	878	I. Cow Run	244
.....	.....	.....	.....	.....	.....	.....	.....	....	245
(500)	(320(	.....	1737	.....	.....	.....	1826	Big Injun	246
.....	.....	.....	.....	.....	.....	.....	.....	Big Injun	247
.....	.....	.....	.....	.....	.....	.....	906	I. Cow Run	248
(530)	(270)	.....	1765	.....	.....	.....	1820	Big Injun	249
.....	.....	.....	.....	.....	.....	.....	.....	Big Injun	250
(440)	(319)	.....	1673	.....	.....	.....	.....	Big Injun	251
(500)	(320)	.....	1715	.....	.....	.....	.....	Maxton and Big Injun	252
(555)	(340)	.....	1765	.....	.....	.....	1926	....	253
700	320	3	1910	.....	.....	.....	2057	....	254
.....	.....	.....	.....	.....	.....	.....	.....	....	255
535	385	3	1760	158	.....	.....	1918	Big Injun	256
.....	.....	.....	1757	.....	.....	.....	1819½	Maxton and Keener	257
300	363	3	1575	.....	.....	.....	1643	Big Injun	258
(320)	(356)	0	1594	.....	.....	.....	1646	Big Injun	259
(275)	(365)	0	1552	.....	.....	.....	.....	Big Injun	260

ter, oil and gas in the Sistersville field appears to be found in its geologic structure. A low anticlinal, or rather quaquaversal (dipping in every direction) uplift passes through the field, and at only one point (a single farm on the Ohio side of the river) does the crest of the fold attain an altitude sufficiently great to lift the reservoir high enough to give sufficient relief for the separation of even the gas from the oil and water, since such vast quantities of all were originally present in the very porous reservoir, the Big Injun Sand being very coarsely pebbly in the Sistersville region."

A short account of the early history of the **Sistersville** oil pool is found on page 359.

The records of the following wells in the Lincoln district portion of the Sistersville field are of interest:

J. B. McCoy No. 12 Well Record (T 10), Lincoln District.

Located on Polecat run, 1.5 mile N. E. of Sistersville. Authority, Henry McCoy of the Reno Oil Co. Completed June 11, 1893.

	Top Feet.
Big Injun sand	1430
Oil pay	1450
Total depth	1500

Made 20,000 bbls. first 21 days and still makes 5 or 6 bbls. per day.

The well records of this field are generally very incomplete. Often only the depth to the oil pay is recorded.

Roome-Iseman No. 8 Well Record (T 11A), Lincoln Dist.

Located on head of Polecat run, 1.5 mile due east of Sistersville. Authority, Carter Oil Co.

	Top Feet.	Thickness Feet.
Coal, Pittsburg	670	6
Cave, bad (reds)	770	238
I Cow Run sand	1008	16
Salt sand	1200	325
Gas at 1375'; water at 1450'.		
Maxton sand	1580	140
Big lime, hard	1760	90
Keener sand	1870	101
Water at 1910'		
Total depth	1971	

	Feet.
Top of **Pittsburg coal** to **I Cow Run sand**	338
Top of **Pittsburg coal** to **Maxton sand**	910
Top of **Pittsburg coal** to **Keener sand**	1200

The complete records of the J. T. Leasure No. 3 (T 12A) and J. B. McCoy No. 15 (T 18A) wells are published in connection with the two sections given for Sistersville on pages 120 and 121 respectively.

Anshutz No. 20 Well Record (T 23), Lincoln District.

Location in southwest corner of Lincoln district, 1 mile and ¾ below Sistersville. Authority Carter Oil Co.

	Feet.	Feet.
Coal, (Sewickley)	150	
Cow Run sand	800 to	830
Salt sand	1000 to	1040
Big lime	1340 to	1420
Break (Keener sand horizon)	1420 to	1440
Big Injun sand	1440 to	1515
First oil pay	1445 to	1455
Second oil pay (good)	1470 to	1490
Total depth		1515

The **Pittsburg coal bed** is noted in only a few wells in this field, coming close 1180 feet above the Keener sand, and in this well its horizon belongs at about 240 feet.

The following is the record of a well drilled by the Carter Oil Co. on the Ohio side, opposite Sistersville and published by Dr. I. C. White in Vol. I (a), page 266, W. Va. Geol. Survey reports:

Mehrley Well, No. 10.

	Thickness Feet.	Total Feet.
Unrecorded	175 to	175
Coal (Washington)	3 to	178
Unrecorded	407 to	585
Coal, Pittsburg	5 to	590
Unrecorded	430 to	1020
"Cow Run" sand (Dunkard)	50 to	1070
Unrecorded	55 to	1125
Sand, **Freeport**	150 to	1275
Unrecorded (contains **"Salt Sand"**)	365 to	1640
"Big Lime" (Mountain)	97 to	1737
"Big Injun" "break" ("Keener") Sand		
Sand (first oil pay at 1757)	78 to	1815

"This shows an interval of 1,147 feet between the **Pitts-**

burg coal and the "Keener" horizon of the "Big Injun" sand, or 1,162 feet to what is known as the "Injun" proper in the Sistersville region, thus showing a thinning of 71 feet in this interval between the Pittsburg coal and the Big Injun sand, in the eight miles from Falls Mills (B. F. Robinson Well, No 2) northwest to Sistersville."

This well record is important in that it gives the exact interval (407 feet) between the Washington and Pittsburg coals and also gives the Washington coal—Keener sand interval as 1559 feet The Sistersville turnpike section on page 121 gives 1587 feet for the same interval.

The following records are from wells located in a detached pool situated on the head of Left Buffalo run, 2½ miles due south of Sistersville. and published on pages 266-267 of the above quoted report.

Dr. J. L. Thistle No. 8 Well Record (T 25), Lincoln Dist. Authority, Carter Oil Co.

	Feet.		Feet.
Pittsburg Coal	410	to	416
Cave	500		
Cow Run Sand (Dunkard)	875	to	883
Salt Sand	970	to	1255
Maxton Sand	1425	to	1435
Big Lime	1523	to	1568
Keener Sand	1568	to	1620

Dr. J. L. Thistle Well No. 9.

	Feet.		Feet.
Pittsburg Coal	505	to	510
Cave	585		
Cow Run Sand (Dunkard)	935		
Salt Sand	1065	to	1410
Maxton Sand	1520	to	1532
Big Lime	1600	to	1640
Keener Sand	1644	to	1698

Dr. J. L. Thistle Well, No. 10.

	Feet.		Feet.
Coal?	580		
Cow Run Sand	930	to	948
Salt Sand	1250	to	1365
Maxton Sand	1455	to	1540
Big Lime	1600	to	1673
Keener Sand	1673	to	1704

"In Thistle wells Nos. 1, 2, 3, 4, 5, 6 and 7 no coal noted; other strata about same."

"Here we see in these records, the patchy nature of the Pittsburg coal over a large portion of Tyler county and the region to the southwest from it. For instance, in the first seven wells on Dr. J. L. Thistle's farm, the coal was too thin to attract notice, while in Nos. 8 and 9 a fair thickness is reported at 1,134 to 1,152 feet above the top of the "Keener" Sand horizon of the "Big Injun," as against 1,147 feet for the same interval at Sistersville (Mehrley well, No. 10). The sand called **"Cow Run"** in these records is not the First Cow Run of Ohio, but the **Dunkard Sand** of Greene county, Pa., while the true Second Cow Run Sand of Ohio belongs 150 to 200 feet below the Dunkard Sand or 400 to 500 feet below the First Cow Run Sand (Saltzburg)."

In the northeast corner of Lincoln district there occurs a structure **dome** on Buck run and Willow fork of Pt. Pleasant creek. Several fair gas wells have been found there in the Keener sand. The following well record shows the horizon in which the gas is found:

J. S. Buck No. 1 Well Record (T 2), Lincoln District.

Located 4.3 miles due east of Sistersville on Willow fork. Authority, Carter Oil Co.

	Feet.	Feet.
Cave	600 to	900
Salt Sand (water, 1200')	950 to	1250
Big Lime	1553 to	1629
Keener Sand (gas, 1628' and 1640')	1628 to	1644

"Good gas well."

Three miles and one-half southwest of the Buck well (T 2) there occurs another small gas pool in the Keener sand. The records of three wells in this pool have been kindly furnished the Survey by Mr. J. T. Ingram of Pursley, W. Va. The logs are as follows:

H. J. Carpenter No. 1 Well Record (T 33), Lincoln District.

On Saltlick run, ½ mile southwest of Pursley. Authority, J. T. Ingram & Co.

	Feet.	Feet.
10-inch casing		100
8¼-inch casing		870

	Feet.		Feet.
Gas sand (Dunkard)	935	to	965
Salt sand (water at 1280')	1260	to	1370
Maxton sand	1460		
6⅝-inch casing			1500
Big lime	1605		
Keener sand	1665		
Gas	1665		
Total depth			1680

According to Mr. Ingram the volume of this well is 2,500,000 cu. ft. of gas per day. The Pittsburg coal, if present, would come close 470 feet in depth or 1195 feet above the Keener sand.

Aaron Scannahorn No. 1 Well Record (T 32), Lincoln Dist.

Located on Saltlick run, ¾ mile southwest of Pursley. Authority, J. T. Ingram & Co.

	Feet.		Feet.
Coal, Native (Washington "A")	25		
10-inch casing	90		
8¼-inch casing	900		
Gas sand (Dunkard)	965	to	995
Salt sand	1290		
Water	1310		
6⅝-inch casing	1400		
Maxton sand	1430		
Big lime	1700		
Keener sand	1685		
First gas	1690		
Total depth	1698		

According to Mr. Ingram the volume of this well is 7,000,000 cu. ft. of gas per day from the Keener sand. It comes close the crest of a small local fold in the rocks. The Pittsburg coal horizon, if present, would belong at a depth of about 500 feet. The coal at 25 feet crops at the foot of the hill road leading to the southeast at Pursley, and appears to represent the Washington "A," coming 1660 feet above the Keener sand.

G. L. Meredith No. 1 Well Record (T 33A), Lincoln District.

Located on Saltlick run, ¾ mile southwest of Pursley and directly opposite A. Scannahorn No. 1, Authority, J. T. Ingram & Co.

	Feet.	Feet.
Native coal (Washington "A")	28	
10-inch casing		120
8¼-inch casing		906
Gas sand (Dunkard)	970 to	1000
Salt sand (water at 1320')	1296 to	1435
Maxton sand	1641	
6⅝-inch casing		1650
Big lime	1655	
Keener sand	1700	
Gas	1710	
Total depth		1720

1,500,000 cu. ft. of gas per day according to Mr. Ingram.

About 2 miles due east of Pursley the Carter Oil Co. drilled a dry hole near the axis of the Shiloh syncline. Its record was published on page 268 of Vol. I (a) of the W. Va. Geol. Survey reports:

A. Heinzman No. 1 Well Record (T 34), Lincoln District.

Located on branch of Pursley, 2 miles due E. of Pursley P. O. Authority, Carter Oil Co.

	Feet.	Feet.
Pittsburg Coal	470	
Cave	700	
Cow Run Sand (Dunkard)	960 to	980
Salt Sand	1016 to	1516
Maxton Sand	1530 to	1550
Big Lime	1597 to	1647
Big Injun Sand	1669 to	1747
Top of Pittsburg coal to Dunkard sand		490
Top of Pittsburg coal to Maxton sand		1060
Top of Pittsburg coal to Keener sand		1177

The **Keener** sand evidently belongs in the "break" at 1647 feet or at the base of the Big Lime and the above interval is calculated to that point.

UNION DISTRICT.

Union district, Tyler county, borders on the Ohio river and extends from Lincoln southwest to the Tyler-Pleasants county line at Bens Run. It is traversed by the same structural folds as Lincoln district; viz., the Sistersville anticline and the Shiloh syncline. Several oil pools are scattered over its area. The principal producing horizons are the **I Cow Run, Maxton, Keener,** and **Big Injun sands.**

The two following well records are from the southwestern end of the Sistersville field, and show the position of the Keener sand at its type locality:

Sarah A. Holmes No. 5 Well Record (T 37), Union District.

Located 1 mile back from the river and 2.4 miles S. W. of Sistersville. Authority, Carter Oil Co.

	Feet.		Feet.
Coal, Washington "A"	160	to	166
Cow Run sand (Dunkard)	1060	to	1085
Salt sand	1150	to	1300
Lime	1750	to	1840
Keener sand	1840	to	1880
"Break"	1880	to	1895
Big Injun sand	1895		
First pay oil	1900	to	1920
Total depth			1950

Oil well in Big Injun sand.

Here the Keener sand is 40 feet thick and separated from the Big Injun sand by 15 feet of slate.

Anshutz No. 12 Well Record (T 39), Union District.

Located 2.4 miles S. W. of Sistersville. Authority, Carter Oil Co.

	Feet.		Feet.
Coal, Pittsburg	218	to	222
Cow Run sand (Lower Freeport?)	723		
Big Lime	1314	to	1368
Keener sand	1368	to	1414
Break of slate	1414	to	1418
Big Injun sand	1418		
First oil pay	1418	to	1423
Second oil pay	1438	to	1450
Total depth			1519

Along the river bottom from Matamoras station to Long Reach there occurs a large number of Keener sand oil wells. The Pittsburg coal horizon is noted in the records of the two following wells scattered along this belt:

Adam Williamson No. 6 or 7 Well Record (T 43), Union Dist.

Upper end of Friendly between R. R. and public road. Authority, Ihrig and Blackmar.

	Feet.		Feet.
Coal, Pittsburg	160	to	167
Horseneck sand (dose of water)	345	to	375
Keener sand	1340		
Big Injun sand	1422		
Oil, light, at (dry hole)	1422		

	Feet,
Top of **Pittsburg coal** to **Keener sand**	1180
Top of **Pittsburg coal** to **Big Injun sand**	1262

Jesse White No. 2 Well Record (T 46), Union District.

Located along Ohio river bottom ¾ mile southwest of Friendly. Authority, Melrose Oil and Gas Co.

	Top Feet.	Thickness Feet.
Coal, Pittsburg	165	
Cave	530	
First Cow Run sand? (Dunkard)	570	15
Second Cow Run Sand? (Lower Freeport)	644	26
Salt sand	928	92
Maxton sand	1159	30
Big lime	1280	65
Keener sand	1345	37
Oil pay	1353	
Total depth	1420	
Top of **Pittsburg coal** to **Dunkard sand**		405
Top of **Pittsburg coal** to **Maxton sand**		994
Top of **Pittsburg coal** to **Keener sand**		1183

About 1 mile southwest of Frinedly there occurs a small oil pool in the **Maxton sand.** The wells on Grandview island just below Friendly are mostly in the Keener sand with the Maxton sand oil at the extreme southwest end of the island. According to L. H. Wilson the John Fonner No. 1 well started off at 50 bbls. of oil per day from the Maxton sand.

Passing on down the Ohio river to Bens Run we find a small oil pool here in the Maxton and Keener sands. The record of the following well was published in Vol. I (a), p. 269 of the State Survey reports by Dr. I. C. White:

J. S. Wells No. 1 Well Record (T 50), Union District.

Located ⅓ mile S. 60°-70° E. of Bens Run Station. Authority, Prof. John F. Carll.

	Feet.	Feet.
Water at		60
Coal **(Sewickley)** at	120	
Cow Run sand	702 to	782
Slate	782 to	792
Sandstone	792 to	800
Slate	800 to	815
Lime	815 to	900
Slate	900 to	995
Sandstone, white	995 to	1005
Slate, black **(gas)**	1005 to	1050

		Feet.	Feet
Slate, white		1050 to	1068
Slate, black		1068 to	1150
Slate and sandstone		1150 to	1160
Sandstone, clear, oil, black		1160 to	1186
Slate and shells		1186 to	1243
Sand (Maxton) good, (oil, 1243)		1243 to	1264
Slate		1264 to	1286
Sandstone and lime (Big)		1286 to	1347
Sand, Keener		1347 to	1412
"Break" (slate)		1412 to	1436
Sandstone, close and hard.. 14′			
Slate, break..... 10′	Big Injun.....	1436 to	1525
(?) ..... 10′			
Sandstone, white..... 55′			
Slate, white, to bottom		1525 to	1605

"The coal bed noted in this record at 120 feet is most probably a representative of the **Sewickley bed**, since it comes 1,227 feet above the Keener Sand, 80 feet more than that shown for this interval at Sistersville, 14 miles to the northeast, hence the horizon of the **Pittsburg coal** would come at about 200 feet in this well. It is needless to say that the stratum called "Cow Run" Sand by the driller is not either the first or second of these oil horizons since the **First Cow Run Sand** comes about 300 feet below the Pittsburg coal, while the **Second Cow Run Sand**, on Cow run, in Ohio, comes 400 feet lower, or about 700 feet below the Pittsburg coal, and thus makes it most probably in the Lower Freeport sandstone horizon of the Allegheny formation."

To support the above conclusion of Dr. White the writer found what appears to be the **Uniontown coal**, cropping about 60 feet above this well, a short distance to the southwest in the edge of Pleasants county. The average thickness of the Monongahela series as shown by the two Sistersville sections on pages 120 and 121, is 315 feet. The above well record would give the Uniontown-Pittsburg coal interval about 250 to 260 feet, giving an interval of 65 to 70 feet from the Uniontown coal up to the Waynesburg bed.

Near the head of Bens run there occurs a fine oil pool in the **I Cow Run Sand**, extending from the Pleasants county line northeastward roughly parallel with the Ohio river along the eastern flank of the Sistersville anticline for 3 miles.

R. C. Massey No. 1 Well Record (T 53), Union District.

On Bens run, 2.4 miles due east of Bens Run Station. Authority, Henaghan and Hanlon.

	Top Feet.	Thickness Feet.
Coal, Waynesburg "A"? (supplied by writer)	5	2
8¼-inch casing 190'.		
6¼-inch casing 716'.		
I Cow Run sand	735	20
First oil pay 736' to 741'.		
Total depth	760	

The coal identified as the **Waynesburg "A"** was not called for in the driller's log, but was supplied by the writer from its crop near by. This coal might possibly represent the Washington bed.

R. C. Massey No. 8 Well Record (T 54), Union District

On Bens run, 250 yards north of Massey No. 1 (T 53). Authority, Henaghan and Hanlon. Top 840' L—A. T.

	Top. Feet.	Thickness. Feet.
Coal, Waynesburg "A" (supplied by writer)	46	2
I Cow Run sand	783	11
Gas at	786	
Oil at	789	
Total depth	794	

These records are very poor and incomplete, but are the best the writer was able to obtain in this field.

During 1908 the Ivy Oil Co., of East Liverpool, Ohio, brought in a 5 barrel oil well in the Big Injun sand at Shiloh in the southwest corner of Union district. Mr. R. E. Pierce, one of the drillers, furnished the writer the following log of this well:

E. J. Osborne No. 1 Well Record (T 61), Union District

Located on the south side of Middle Island creek at Shiloh. Authority, Ivy Oil Co., and R. E. Pierce.

	Top. Feet.	Bottom Feet.
Coal, Pittsburg	350 to	355
First Cow Run sand? **(Murphy)**	500	
Cave		
Second Cow Run sand? **(Dunkard)**	820	
Salt sand	1000	

	Top Feet.	Bottom Feet.
Maxton sand	1450	
Keener sand	1540	
Big Injun sand, gas at top	1562	
Oil pay, 5 bbls. at	1581	
Total depth		1600

	Feet.
Top of **Pittsburg coal** to **Murphy sand**	150
Top of **Pittsburg coal** to **Dunkard sand**	470
Top of **Pittsburg coal** to **Maxton sand**	1100
Top of **Pittsburg coal** to **Keener sand**	1190
Top of **Pittsburg coal** to **Big Injun sand**	1212

It is very evident here that the driller's identifications of the true **I and II Cow Run** sands are wrong and that the above horizons really represent the **Murphy** (Morgantown) and **Dunkard** (Mahoning) sands.

One mile and a half northeast of Shiloh there occurs a good Keener sand oil pool at Bowles Mills (Little P. O.). The following well record shows the horizon at which the oil is found:

John Lady No. 2 Well Record (T 62), Union District.

Located on west side of Middle Island creek at Bowles Mills. Authority, McCutcheon Bros.

	Feet.		Feet.
Coal (Uniontown)	175	to	177
Hurry-Up sand **(Murphy)**	470	to	500
I Cow Run sand	720	to	740
Salt sand	1000	to	1250
Big Lime	1466	to	1517
Keener sand (oil at 1538')	1517		
Total depth			1550

The Pittsburg coal horizon possibly occurs at a depth of 325 to 350 feet and the sand identified by the driller as the "**Hurry Up**" is possibly the **Murphy** (Morgantown) horizon. One mile east of Bowles Mills there occurs a small **Salt sand** oil well on the Addie Knowlton farm (T 65). This is the only oil well found by the writer at this horizon in the three counties.

One mile and a half northeast of Bowles Mills there occurs another Big Injun sand oil pool on Buffalo run. This pool is located on both flanks of the Shiloh syncline. The records

in this field are very incomplete, only the depth being given to the top of the Big Injun sand.

About one mile due west of Next P. O., McKeever and Gailey drilled in a great salt water well on the north bank of Middle Island creek on the Jos. Archer farm (T 68). This well is located near the axis of the Shiloh syncline. Dr. I. C. White[22] gives the following interesting account concerning this well:

"Before leaving Tyler a word must be said of the great salt water geyser which was struck on Middle Island creek, a few miles below Middlebourne. The next year after the Sistersville field was opened, a well was drilled into the **"Big Injun" sand** on Middle Island creek, reaching the same at a depth of 1,562 feet, and striking a vast pool of salt water which gushed forth in a constant stream to the height of 120 feet, at the rate of 16,000 barrels daily, as gauged by C. S. Lyon, the engineer. The flow continued for several months, but the well gradually weakened and finally produced five or six barrels of oil daily along with salt water. The level of the derrick floor at the great salt water well is 668 feet above tide, or 83 feet higher than low water in the Ohio river at Sistersville, according to Mr. Lyon."

The following is the record of a well on Buffalo run, 2 miles northwest of Bowles Mills and 4 miles due south of Sistersville:

W. A. Beagle No. 1 Well Record (T 44). Union District

Authority, Cartor Oil Co.

	Top. Feet.	Bottom Feet
Cave, bad	600	760
Cow Run sand, poor **(Dunkard)**	822	852
Salt sand, hard	1100	1230
Maxton sand, good	1476	1493
Big Lime, soft	1500	1565
Big Injun sand, good (water at 1610')	1565	1675
Total depth		1684

The **Pittsburg coal** horizon should come about 375 feet in depth. This well was a dry hole.

22. Vol. I, page 361, W. Va Geol. Survey.

ELLSWORTH DISTRICT.

Ellsworth district adjoins Wetzel county on the north and Lincoln and Union districts of Tyler on the west. Its area is traversed by three structural folds; viz., the Shiloh and Middlebourne synclines and the Wick anticline. In that portion of its area north from Middlebourne there occurs four large oil pools located on what the writer has termed the **Elk Fork terrace** (see page 71). The rocks rise very rapidly for two to three miles southwestward from the mouth of Little Fishing until the waters of Tenmile and Elkfork branches of Pt. Pleasant creek are reached, when they appear to gradually flatten out, making ideal conditions for the segregation of oil into pools of commercial value. On Elk fork were found some of the largest wells in the State. The oil horizon appears to be mostly in the Keener sand, although some wells were found in the main bed of the Big Injun sand. As a rule, the records kept in this old Elk fork pool are very poor. The following logs are of some interest however:

N. C. Fluharty No. 3 Well Record (T 74), Ellsworth District

Located on Wolfpen run of Tenmile run, ¾ mile S. 80°-85° E. of Sandusky P. O. Authority, South Penn Oil Co.

	Feet.
Keener sand	1802
Oil pay	1826
Total depth	1847

J. T. Farrell No. 1 Well Record (T 78), Ellsworth District.

Located on the east bank of Mudlick run of Elk fork, ¾ mile north of Lonetree P. O. Authority, Carter Oil Co.

	Top. Feet.	Thickness. Feet.
Coal, (Washington)	80	2
Cave	600	340
Salt sand (Dunkard)	1038	40
Salt sand (Lower Freeport)	1162	54
Salt sand (II Cow Run)	1246	73
Salt sand	1319	336
Maxton sand	1655	15
Big Lime	1696	88

	Top Feet.	Thickness Feet.
Keener sand	1784	22
Big Injun sand	1806	45
Oil at	1841	
Total depth	1851	

The **Pittsburg coal** horizon should come about 550 feet in this well and the identifications by the writer in **parentheses** are made on that basis, as well as in the following well record.

Sarah McCormick No. 1 Well Record (T 79), Ellsworth

Located ⅛ mile southeast of J. T. Farrell No. 1 (T 78). Authority, Carter Oil Co.

	Feet.	Feet.
Coal, (Washington)	155 to	158
Coal, (Waynesburg "A")	218 to	221
Big Injun sand	1825	

Wm. Farrell No. 1 Well Record (T 81), Ellsworth District.

Located at Polard P. O. on Elk fork, 2.2 miles S. E. of Kidwell. Authority, South Penn Oil Co. (791′ L—A. T.)

	Feet.
Keener sand	1693
Gas at	1693
Oil at	1697
Total depth	1724

The **Washington coal** crops 31 feet below the top of the well, giving its interval down to the Keener sand here as 1662 feet, 60 to 75 feet greater than at Sistersville, 8½ miles to the northwest. Between the mouth of Tenmile run and Elk fork on the west side of Point Pleasant creek there occurs a large number of oil wells from the Keener sand. The abbreviated records of T 70 and T 72 are found in the tabular list of Tyler county wells on page 476.

At Kidwell there are a few wells in the Big Injun sand. The record of the following well on the Haught farm makes it clear that the oil comes from the main bed of the Big Injun:

Elias Haught No. 1 Well Record (T 87), Ellsworth District.

Located on the north side of Kidwell at the mouth of Elk fork. Authority, Melrose Oil & Gas Co.

	Feet.	Feet.
Hurry-Up sand	295	
Cave	550	
Salt sand	930	
Maxton sand	1390 to	1475
Big Lime	1555 to	1615
Keener sand	1635 to	1660
Big Injun sand	1660	
Gas at 1698'; oil, gas, and water at 1704'.		
Total depth		1705

The abbreviated records of other wells (T 85), (T 88) and (T 89) are in the table of Tyler county wells on page 476.

Near the mouth and on both sides of Pt. Pleasant creek, north from Middlebourne, there occurs a large number of wells in both the Dawson (Maxton?) and Keener sands. The following well records from this pool are of interest:

M. H. Stealy No. 1 Well Record (T 94), Ellsworth District.

Located on Pt. Pleasant creek, ⅓ mile above mouth Authority, South Penn Oil Co.

	Feet.	Feet.
Coal, Pittsburg	**none**	
Hurry-Up sand (**Sewickley**) (always bad for water)	260 to	300
Salt sand (water at 900')	870 to	1320
Lime		
Dawson sand (oil pay, 11 bbls.)	1531 to	1541
Big Lime	1541 to	1604
Keener sand	1604 to	1619
Oil pay (110 bbls.)	1604 to	1619
Total depth		1619

The **Dawson sand** really appears to occur at the same horizon as the **Maxton** of northern Wetzel county, with this difference that it appears to lie in closer contact with the Big Lime below.

J. G. King No. 5 Well Record (T 95), Ellsworth District.

Located ¼ mile southeast of M. H. Stealey No. 1. Authority, South Penn Oil Co.

	Feet.	Feet
Coal, (Uniontown)	315 to	317
Hurry-Up sand (Sewickley)	430 to	470
Salt sand	1050 to	1575
Dawson sand	1704 to	1719
Oil pay, 60 bbls. at 1704'. Nice amber colored oil.		

J. G. King No. 1 Well Record (T 96), Ellsworth District.

Located on hill, ½ mile due north of Middlebourne. Authority, South Penn Oil Co.

	Feet.		Feet.
Coal, Native (Washington)	275	to	277
Coal, Pittsburg? (Uniontown)	470	to	471
Hurry-Up sand (Sewickley)	575	to	615
Cave	827	to	1112
Salt sand	1225	to	1773
Unrecorded, limestone at bottom	1773	to	1875
Dawson sand	1875	to	1921
Gas			1913
Oil (good show)			1918
Big Lime	1921	to	1938
Keener sand	1938	to	1960
Oil, 15 bbls			1947
Total depth			1973

This is an oil well in both the **Dawson** and **Keener** sands. The coal coming at 470 feet undoubtedly represents the Uniontown bed and the horizon of the Pittsburg coal belongs at 715 feet, or 1225 feet above the top of the Keener sand as shown by the log of J. R. Baker No. 1 (T 111). 2 miles south of there.

John King No. 2 Well Record (T 97), Ellsworth District.

Authority, South Penn Oil Co. Top, 853′ A. T.

	Feet.		Feet
Coal, Native, Washington	123	to	124
Coal, Uniontown (steel line)	317	to	319
Hurry-Up sand (Sewickley)	434	to	474
Big Lime (steel line)	1700	to	1769
Keener sand	1769	to	1800
First pay oil	1781		
Total depth			1800

The **Uniontown** coal bed seems fairly persistent in this region.

Israel Folger No. 3 Well Record (T 99), Ellsworth District.

Two miles northeast of Middlebourne. Authority, South Penn Oil Co.

	Feet.		Feet
Hurry-Up sand (Sewickley)	795	to	845
Coal, Pittsburg	none		
Salt sand	1370	to	1620
Big Lime	2093	to	2159
Keener sand (steel line)	2159	to	2187
Big Injun sand	2187	to	2337
Berea sand (steel line)	2562	to	2580

	Feet.		Feet.
Gordon Stray sand (steel line)	2950	to	2954
Gordon sand, shale	3021	to	3024
Slate and shells to			3840
Total depth			3840

The Pittsburg coal horizon belongs at 930 feet, or very close that figure. Hence the following:

	Feet.
Top of **Pittsburg coal** to **Keener sand**	1230
Top of **Pittsburg coal** to **Berea Grit sand**	1632
Top of **Pittsburg coal** to **Gordon Stray sand**	2020
Top of **Pittsburg coal** to **Gordon sand shells**	2091
Top of **Pittsburg coal** to Bottom of hole	2910

This well evidently penetrated below the Speechley sand.

David Hickman No. 1 Well Record (T 100), Ellsworth

Northeast edge of Middlebourne. Authority, South Penn Oil Co. Completed Oct. 21, 1903.

	Feet.		Feet
Coal, Native **(Washington)**	50	to	51
"Hury-Up" sand, (Sewickley)	356	to	391
Pittsburg coal	none		
Big Lime	1648	to	1698
Keener sand	1698		
Big Injun sand	1748	to	1860
Oil show	1755		
Water	1794		
Berea Grit sand (water at 2080')	2080	to	2095
Lime shells at	2508		
Lime shells **(Gantz sand)**	2340		
Lime shells **(Pencil cave)**	2590		
Lime shells **(Stray sand)**	2637		
Lime shells **(Gordon sand)**	2708		
Total depth			2875

This well was considered dry and abandoned.

The South Penn Oil Co. drilled a Maxton sand oil well on the south side of Middle Island creek, ¼ mile below the mouth of Gorrell run. The record of this well is as follows:

J. R. Maloy No. 1 Well Record (T 105), Ellsworth District.

Located in south edge of Middlebourne. Authority, South Penn Oil Co.

	Feet.		Feet
Hurry-Up sand **(Sewickley)**	260	to	280
Coal, Pittsburg	none		
Salt sand (water at 840' and 1280')	840	to	1280
Maxton sand	1440	to	1500
First oil pay	1490	to	1500

This well made 87½ bbls. for the first 24 hours of nice amber colored oil.

K. S. Boreman No. 2 Well Record (T 103), Ellsworth

Located on branch of Gorrell run, 1 mile east of Middlebourne. Authority, McCutcheon Bros.

	Feet.		Feet.
Coal, Native (**Washington**)	65		
Coal, **Uniontown**	260	to	265
Hurry-Up sand (Sewickley)	360	to	400
Cave	650		
Salt sand	1000	to	1390
Maxton sand	1566	to	1589
Keener sand	1749		
Gas show	1755		
Total depth, and dry			1858

Mary Jemison No. 3 Well Record (T 104), Ellsworth District

Located ⅓ mile south of Boreman No. 2 (T 103). Authority, Octave Oil Co.

	Feet.	Feet.
Coal. Native (**Washington**)	120	
Hurry-Up sand (Sewickley)	420	
Keener sand	1797	
Oil show	1801	
Oil show	1813	
Big Injun sand	1827	
Water and total depth (dry)	1882	

On Gorrell run, one mile and three-fourths due west of Middlebourne, there occur several oil wells in the **Dawson** or **Maxton** sand, located around the **nose** of the Wick anticline. The following is the record of a well in this pool:

J. G. Gorrell No. 4 Well Record (T 107), Ellsworth District.

Located one mile and three-fourths west of Middlebourne. Authority, Melrose Oil & Gas Co.

	Top	Feet.
Cave		490
Maxton sand		1475
Lime		1505
Keener sand		1548
Break		1583
Big Injun sand (water at 1625')		1593
Total depth		1643

This well was abandoned as a dry hole.

About 1 mile south of the Gorrell well and farther up the slope of the anticline the same company drilled in a light well in the Maxton sand. Its record is as follows:

Pierpont Estate No. 1 Well Record (T 110), Ellsworth

Located on head of branch of Middle Island creek, 2-¼ miles S. W. of Middlebourne. Authority, Melrose Oil & Gas Co.

	Feet.		Feet.
Coal, Uniontown	306	to	310
Cow Run sand	900	to	915
Salt sand	975	to	1380
Maxton sand (gas at 1700')	1677	to	1715
Lime	1719	to	1760
Keener sand	1758	to	1788
Break	1788	to	1792
Big Injun sand	1792		
Total depth			1872

The **Pittsburg coal horizon** should come at close 535 feet in this well. or 1220 to 1225 feet above the Keener sand.

About 2 miles south of Middlebourne on Sancho creek, the Carter Oil Company drilled a dry hole on the J. R. Baker farm (T 111), the record of which is published on page 117 in connection with the section for Middlebourne. This well reported 3 feet of **Pittsburg coal**, coming 1225 feet above the base of the Big lime or top of the Keener division of the Big Injun sand and this interval was used by the writer in drawing the structure contours on the top of the **Pittsburg coal** horizon in the Middlebourne region (See economic geology map accompanying this report).

The same company drilled another dry hole one mile and a quarter farther up Sancho creek near the extreme southern point of Ellsworth district. Its record is as follows:

Mary E. Johnson No. 1 Well Record (T 112), Ellsworth

Located 1 Mile N. E. of Sancho P. O., at mouth of Foster run of Sancho creek. Authority, Carter Oil Co.

	Feet.		Feet.
Cave	485	to	755
I Cow Run sand	755	to	770
Cow Run sand (Dunkard)	855	to	880
Salt sand? (Lower Freeport)	1040	to	1100
Salt sand	1115	to	1265
Big Lime	1555	to	1615
Keener sand	1615	to	1661
Big Injun sand (oil show at 1705')	1661	to	1751
Squaw sand	1771	to	1791
Total depth			1881

Dry hole.

The **Pittsburg coal horizon** belongs near 390 feet.

About 2 miles southeast of Middlebourne there occurs a group of oil wells on the "Jug" and on the west side of Middle Island creek, opposite the latter area. The oil is found in both the **Maxton** and **Keener** sands, the pool being located a short distance up the western flank of the Middlebourne syncline. The following records of two wells on the "Jug" show the horizons in which the oil and gas are found:

F. L. Rymer No. 1 Well Record (T 115), Ellsworth District.

Located 2 miles southeast of Middlebourne on the west edge of the "Jug". Authority, South Penn Oil Co.

	Feet.
Coal, Pittsburg? (Sewickley?)	417
Dunkard sand	930
Maxton sand	1540
Keener sand	1708
Gas at 1710'; oil at 1712'.	
Total depth	1726

Produced 345 bbls. of oil first 24 hours from the Keener sand.

	Feet.
Top of **Pittsburg coal? to Dunkard sand**	513
Top of **Pittsburg coal? to Maxton sand**	1123
Top of **Pittsburg coal? to Keener sand**	1291

The measures thicken up very rapidly southeast of Middlebourne as is revealed by the above interval for the **Pittsburg coal** and **Keener** sand.

Samuel Attleberger No. 3 Well Record (T 117), Ellsworth

On the southwest end of the "Jug". Authority, South Penn Oil Co.

	Feet.	Feet.
Maxton sand (oil at 1570')	1562 to	1575
Keener sand (some gas)	1713	
Big Injun sand	1790	
Total depth		1810

Produces oil from Maxton sand.

About 2½ miles due east of Middlebourne, there occur three small wells in the Keener sand. The following is a record of one of these wells:

W. W. Allen No. 1 Well Record (T 102), Ellsworth

Located 2½ miles due east of Middlebourne. Authority, Pure Oil Co.

	Feet.		Feet.
Coal, Uniontown	375	to	378
Cave	770		
Big Lime	1795	to	1879
Keener sand	1877		
Water	1883		
Big Injun sand	1909		
Water	1966		
Total depth			1980

The Uniontown coal is reported 3 feet thick, coming 1502 feet above the Keener sand.

On Muddy creek of Middle Island creek, 4¾ miles S. 80°-85° E. of Middlebourne, there occur 10 to 15 oil wells on the western slope of the Big Moses anticline. The producing horizons are the **Maxton, Big Injun** and **Gordon** sands. The records of the following wells, 4 in number, give important data with reference to both the **oil and gas horizons** and the **coal beds**:

Isaiah Baker No. 5 Well Record (T 120), Ellsworth

Located on Muddy creek branch of Middle Island creek, 1 mile N. E. of Frew P. O. Authority, South Penn Oil Co.

	Feet.		Feet.
Hurry-Up sand (**Sewickley**) (steel line)	562	to	587
Coal, Pittsburg	682	to	688
Cave	850	to	1130
Maxton sand (steel line)	1795	to	1815
Big Lime	1849	to	1927
Keener sand (steel line)	1927	to	1957
Water (steel line)	1940	to	1940
Big Injun sand (steel line)	1957	to	2070
Total (steel line)			2080

Dry hole.

With hot water at pay horizon in Big Injun sand, got just a rainbow color on water.

Top of **Pittsburg coal** to **Maxton sand**	1113
Top of **Pittsburg coal** to **Keener sand**	1245
Top of **Pittsburg coal** to **Big Injun sand**	1275

A good thickness (6 feet) of **Pittsburg coal** is reported in this well, but reported missing in other wells close by. The Hurry-Up (**Sewickley**) sand is used as a key rock by the drillers.

Isaiah Baker No. 7 Well Record (T 121), Ellsworth District.

Located ¼ mile N. E. of I. Baker No. 5 (T 120), on Muddy creek. Authority, South Penn Oil Co.

Top 898' A. T. (Hand level).

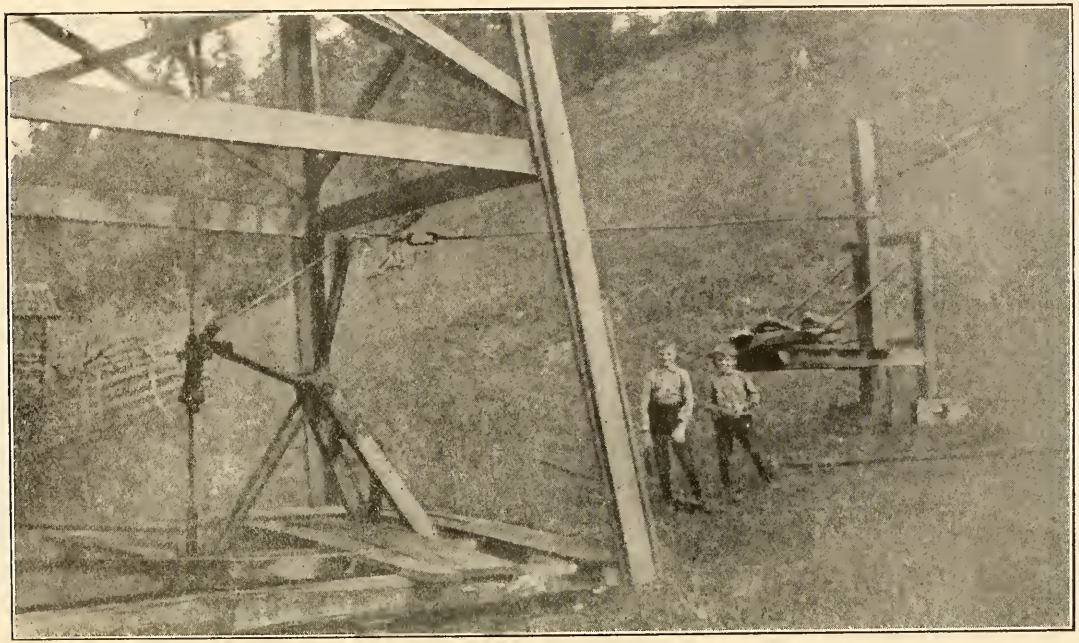

Plate XI.—Showing Method of Pumping Oil Wells (J. S. Riggs No. 2), McKim Field, Tyler County. (For Record see Page 530).

	Feet.	Feet.
Hurry-Up sand (Sewickley)	453 to	483
Coal, Pittsburg (horizon 566')	none	
Cow Run sand (Dunkard)	1035 to	1065
First Salt sand (II Cow Run)	1345 to	1365
Second Salt sand	1400 to	1515
Maxton sand (steel line)	1705 to	1713
Big Lime	1765 to	1830
Keener sand	1830 to	1880
Big Injun sand	1880	
First oil pay	1918 to	1924
Total depth		1926

Isaiah Baker No. 3 Well Record (T 122), Ellsworth District.

Located ⅛ mile southeast of I. Baker No. 5 (T 120), on Muddy creek. Authority, South Penn Oil Co.

	Feet.	Feet.
Hurry-Up sand	367 to	397
Pittsburg coal (none)	480 to	480
Cow Run sand (Dunkard)	807 to	822
Maxton sand	1620 to	1626
All pay of black oil.		
Big Lime	1683 to	1746
Keener sand	1746 to	1786
Big Injun sand (top, blue)	1786 to	1846

Water at 1786'; oil pay, 385 bbls. first 24 hours at 1836'.

The last two records show that the **Pittsburg** coal is very unreliable in Tyler county even where isolated wells report a good thickness of this seam.

Anderson Stealey No. 1 Well Record (T 124), Ellsworth

Located on Muddy creek branch of Middle Island creek, 1 mile and eight-tenths N. E. of Frew P. O. Authority, South Penn Oil Co.

	Feet.	Feet.
Coal, Pittsburg (steel line)	695 to	698
I Cow Run sand	1040 to	1065
Salt sand	1202 to	1695
Big Lime	1900 to	1985
Keener sand (steel line)	1989 to	2000
Break of slate (steel line)	2000 to	2005
Big Injun sand	2005 to	2054
Water (steel line)	2064	
Gordon Stray sand (steel line)	2730 to	2745
Gordon sand (steel line)	2764 to	2766
Gas, light show (steel line)	2764	
Total depth (steel line)		2764

The pocket of gas encountered in the Gordon sand exhausted itself in 18 hours.

	Feet.
Top of **Pittsburg coal** to **1 Cow Run sand**	345
Top of **Pittsburg coal** to **Keener sand**	1284
Top of **Pittsburg coal** to **Big Injun sand**	1310
Top of **Pittsburg coal** to **Gordon Stray sand**	2035
Top of **Pittsburg coal** to **Gordon sand**	2069

On the head of Elk fork in the eastern portion of Ellsworth district in the vicinity of Iuka and Conaway there occurs a small field of **Big Injun** sand wells along the western flank of the Big Moses anticline. The following record from this field is of special interest in that the horizon of the **Pittsburg coal** bed is given:

Albert Kinney No. 1 Well Record (T 128), Ellsworth.

Located on Laura run of Elk fork, one-eighth mile south of Iuka. Authority, South Penn Oil Co.

	Feet.	Feet.
Coal, Pittsburg	483	
Cow Run sand **(Dunkard)**	970	
Salt sand	1500	
Maxton sand	1655	
Pencil cave	1718	
Big Lime	1725	to 1760
Keener sand	1760	
Big Injun sand	1780	
Gas and oil at	1843	
Total depth		1860

	Feet.
Top of **Pittsburg coal** to **Maxton sand**	1172
Top of **Pittsburg coal** to **Keener sand**	1277
Top of **Pitsburg coal** to Big Injun sand	1297

The abbreviated records of other wells (T 112, T 130, and T 131), in this field are found in the Tyler county table of wells on page 476.

McELROY DISTRICT.

McElroy district occupies the eastern portion of Tyler county, taking in that portion of the latter area drained by the waters of Indian and McElroy creeks. This district is traversed in a northeast-southwest direction by one great structural fold; viz., the Big Moses anticline. Along the crest of this arch in the rocks and a short distance down both slopes there occurs a large number of gas wells scat-

tered from the Ellsworth-McElroy district line on the north to the Tyler-Doddridge county line on the south. On both flanks of this arch there occur two large oil fields; viz., the **Big Moses oil field** on the west, and the great **Stringtown oil field** on the east.

The **Kyle pool** of Indian creek is located east from Big Moses P. O. The record of the following well is of interest:

Lloyd Weekly No. 1 Well Record (T 147), McElroy District.

In Big Moses field. Authority, American Oil and Development Co.

	Feet.		Feet.
Cow Run sand	870	to	945
Salt sand	1000	to	1200
Big Lime	1630	to	1710
Break	1710	to	1715
Big Injun sand	1777		
Gas at 1715' and 1777'.			
First oil pay	1777		
Total depth			1777

This well made 1800 bbls daily from the **Big Injun sand** for two or three weeks.

Another well, the J. W. Kyle No. 1, located 200 to 300 feet southeast of the Weekly No. 1 (T 147) is reported to have made 1800 bbls. per day from the **Big Injun sand** for over eight months. The Kyle well is 15 years old and still makes 5 to 6 bbls. daily. On Booher run in this field are found several **Maxton sand** oil wells, the largest of which, D. M. Booher No. 5, had a 75 bbls. daily initial production. The oil grades as **amber oil** in the market.

The following is the record of the famous **Big Moses** gas well:

Moses Spencer No. 1 Well Record (T 148), McElroy District.

Located at Big Moses P. O., on Indian creek. Authority, Victor Oil and Gas Co.

	Feet.		Feet.
Conductor	0	to	14
10-inch casing			158
Coal	740	to	744
Cow Run sand	800	to	820
8¼-inch casing			1050
Salt sand	1200	to	1290
Keener sand	1710		
Big Injun sand (gas)	1750		

Dr. I. C. White gives the following interesting account of this gas well in Vol I, page 358 of State Survey reports:

"The Kyle pool of Tyler is on the waters of Indian creek, near the "Big Moses" gas well, one of the largest gas flows ever struck. The flames from this well when burning through 8¼-inch casing, ascended to a height of 173 feet, according to accurate measurements made by Mr. C. S. Lyon, the civil engineer of Sistersville. Mr. Browne of the Phildelphia Gas Company estimated its out-put at more than fifty million cubic feet daily, and this was the objective point of the great 16-inch gas line of that company which was extended from the Pennsylvania gas fields across Greene Wetzel and Tyler counties, a distance of 60 miles. But before the connection could be made with the "Big Moses" well ,on the Moses Spencer farm, 2 miles above the mouth of Indian creek, the Kyle oil pool had been opened near by in the same sand("Big Injun") and the glory of the "Big Moses" had departed, not through one well but through scores of them."

This well has long ago been abandoned.

Moses Spencer No. 2232 Well Record (T 149),McElroy

Located 600 to 800 feet south of "Big Moses" Well. Authority, Philadelphia Company.

	Feet.		Feet
Coal, Pittsburg	432	to	434
Little Dunkard sand	823	to	833
Gas sand (Lower Freeport)	1055	to	1084
Salt sand	1110	to	1470
Little Lime	1624	to	1640
Pencil cave	1640	to	1674
Big Lime	1674	to	1757
Big Injun sand	1757	to	1932
Light gas pay 60' to 70' from top of sand.			
Gordon sand (no gas)	2502	to	2518
Slate, soft	2518	to	3037
Total depth			3037
Abandoned.			
Top of Pittsburg coal to Big Injun sand			1325
Top of Pittsburg coal to Gordon sand			2070

D. N. Furbee and Bros. No. 4 Well Record (T 153), McElroy District.

Located on McElroy creek, one-third mile west of Ankrom P. O. Authority, American Oil and Development Co. Top 852′ A. T. (Hand level.)

	Feet.		Feet.
Conductor	0	to	14
10-inch casing			176
Coal, Pittsburg	520		
Red cave	720		
Cow Run sand **(Dunkard)**	1020		
Gas sand **(Lower Freeport)**	1125		
Salt sand	1217		
Maxton sand	1712		
Little Lime	1723		
Pencil cave	1743		
Big Lime	1753		
Big Injun sand	1834	to	1955
Break	1892		
Squaw sand	1960		
Berea sand	2260		
Red rock	2458		
Stray sand, shells	2520		
Gordon sand	2568	to	2582
Gas in Gordon sand	2573		
Fourth sand, shells	2611		
Total depth			2618½

Fair gas well, 600 lbs. pressure.
Volume=10 inches on a mercury gauge in 6¼-inch casing.

	Feet.
Top of **Pittsburg** coal to **Maxton sand**	1192
Top of **Pittsburg** coal to **Big Injun sand**	1314
Top of **Pittsburg** coal to **Squaw sand**	1440
Top of **Pittsburg** coal to **Berea sand**	1740
Top of **Pittsburg** coal to **Red rock**	1938
Top of **Pittsburg** coal to **Gordon Stray sand**	2000
Top of **Pittsburg** coal to **Gordon sand**	2048
Top of **Pittsburg** coal to **Fourth sand**	2091

The abbreviated records of other wells (T 150, T 151, and T 152) in this field are found on page 476 in the table of Tyler county wells.

The following is the record of a gas well on Indian creek, located slightly over a mile northwest of Big Moses P. O.:

M. W. Spencer No. 1 Well Record (T 135), McElroy

Authority, Philadelphia Company. Completed Aug. 25, 1908.

	Feet.		Feet.
Coal, Pittsburg	370	to	372
Cow Run sand (**Lower Freeport**)	990	to	1050
Gas sand (**II Cow Run**)	1052	to	1102
Salt sand	1115		
Salt Sand	1335	to	1390
Little Lime	1585	to	1600
Pencil cave	1600	to	1608
Big Lime	1608	to	1705
Big Injun sand	1705	to	1875
Sandy lime, shells and slate	1875	to	2445
Gordon sand	2445		
Gas pay	2461	to	2466
Total depth			2480

	Feet.
Top of **Pittsburg coal** to **Big Injun sand**	1335
Top of **Pittsburg coal** to **Gordon sand**	2075

The following gas well records are scattered along the Big Moses anticline from north to south across McElroy district:

Samuel Woodburn No. 1 Well Record (T 139), McElroy

Located 2 miles northeast of Booher P. O. on Woodburn run of Indian creek. Authority, Carter Oil Co.

	Feet.		Feet.
Coal, Pittsburg	530	to	534
Cow Run sand	973	to	993
Salt sand	1115	to	1430
Stray? sand, (Maxton) (gas)	1695	to	1699
Big Lime	1740	to	1836
Big Injun sand	1836	to	1921
Gordon sand, (4′ good)	2591	to	2599
Total depth			2650

	Feet.
Top of **Pittsburg coal** to **Maxton sand**	1165
Top of **Pittsburg coal** to **Big Injun sand**	1306
Top of **Pittsburg coal** to **Gordon sand**	2061

Gas well in Maxton sand.

The very complete detailed log of the W. W. Myers No. 1 well (T 137) located 2 miles west of the Woodburn well, is published on page 114 in connection with the Big run section.

Smith and Furbee No. 1 Well Record (T 144), McElroy

Located 1 mile and a third southeast of Big Moses P. O. Authority Philadelphia Company. Completed, Feb. 8, 1907.

	Feet.		Feet.
Coal, Pittsburg	807	to	810
Little Dunkard sand	1195	to	1212
Salt sand (Lower Freeport)	1480	to	1550
Salt sand	1600	to	1680
Maxton sand	1970	to	1977
Little Lime	2007	to	2019
Big Lime	2040	to	2140
Big Injun sand	2140	to	2300
Gas at	2200	to	2205
Gordon sand	2870	to	2884
Gas at	2877	to	2882
Total depth			2900
Top of **Pittsburg coal** to **Maxton sand**			1163
Top of **Pittsburg coal** to **Big Injun sand**			1333
Top of **Pittsburg coal** to **Gordon sand**			2063

Gas was encountered in this well in both the **Big Injun** and **Gordon** sands.

John Groves No. 1 Well Record (T 145), McElroy District.

Located on head of Grove run of Indian creek, 1 mile S. E. of Big Moses P. O. Authority, Philadelphia Co.

	Feet.		Feet
Coal, Pittsburg	579	to	....
Little Dunkard sand	920	to	985
Big Dunkard sand	1055	to	1070
Gas sand **(Lower Freeport)**	1175	to	1187
Gas sand **(II Cow Run)**	1210	to	1288
Salt sand (water at 1380')	1336	to	1416
Salt sand	1500	to	1614
Little Lime	1775	to	1793
Big Lime	1821	to	1916
Big Injun sand	1916	to	2076
Show of gas and oil	1980	to	1987
Gordon sand	2645	to	2662
Light gas	2656		
Slate and shells to bottom	2662	to	2954
Well abandoned and plugged.			
Top of **Pittsburg coal** to **Salt sand**			921
Top of **Pittsburg coal** to **Big Injun sand**			1337
Top of **Pittsburg coal** to **Gordon sand**			2066
Top of **Pittsburg coal** to **Bottom of hole**			2375

Zane Underwood No. 2 Well Record (T 154), McElroy

Located on south bank of Indian creek, 1.6 mile S. 15°-25° W. of Big Moses P. O. Authority, Philadelphia Co.

	Feet.		Feet.
Coal, Pittsburg	490	to	494
Big Dunkard sand	1004	to	1050
Gas sand **(Lower Freeport)**	1095	to	1138
Salt sand	1166	to	1304

	Feet.		Feet.
Little Lime	1714	to	1720
Pencil cave	1720	to	1739
Big Lime	1739	to	1819
Big Injun sand	1819	to	1990
Gas at 1884′ and 1894′; oil at 1908′.			
Gordon sand	2543		
Gas at 2553′ and 2555′.			
Total			2580
Fair show of oil in Big Injun sand.			
Best gas from Gordon sand.			
Top of **Pittsburg coal** to **Big Injun sand**			1329
Top of **Pittsburg coal** to **Gordon sand**			2053

The following is the record of a well in the extreme southern part of McElroy district, published by Dr. I. C. White in Vol I (a), page 251 of the State Survey reports:

J. L. Ash No. 1 Well Record (T 157), McElroy District.

Located 6-10ths mile due south of Wilbur on branch of Camp Mistake run. Authority, Carter Oil Co.

	Feet.		Feet.
Coal, poor (**Washington**)	50	to	52
Cave ("Big red")	765	to	980
Cow Run Sand (**Dunkard**)	980	to	995
Salt Sand (Lower Freeport)	1200	to	1245
Salt Sand	1480	to	1515
Maxton Sand	1610		
Big Lime	1765	to	1852
Big Injun Sand (gas)	1854	to	1940
Slate	1924	to	1934
Slate to bottom	1965	to	1972

The coal at 50 feet is undoubtedly the Washington since the crop of the latter bed is exposed 50 feet lower than the well mouth, a short distance north from the well. The Pittsburg coal horizon belongs near 520 feet, but was not recorded in the well. The W. W. Pratt No. 1 well (T 158) located ⅓ mile northeast of Camp P. O., near the Doddridge county line is a Big Injun sand gas well. The latter starts 33 feet (hand-level measurement) below the outcrop of the Washington coal, and the Pittsburg coal is encountered in the well at a depth of 430 feet, giving the Washington-Pittsburg coal interval as 463 feet, which is close the estimate in the J. L. Ash well above. The Pratt well (T 158) is very close the axis of the Big Moses anticline and the prospects appear very favorable for gas wells along this arch between

Indian creek and Camp P. O. on the Doddridge county line

There are two small Dunkard sand oil wells close the Doddridge county line in the edge of McElroy district, located 1 mile southeast of Shirley on the eastern flank of the Big Moses arch. The record of the following dry hole close by gives the position of the Dunkard sand in this region:

Underwood and Orr No. 3 Well Record (T 163), McElroy

Located 1 mile southeast of Shirley. Authority, South Penn Oil Co.

	Feet.	Feet.
Coal, Pittsburg (steel line)	761 to	762
Cave	970	
Hole reduced	1147	
Dunkard sand	1194 to	1217
Slate	1217 to	1223
Big Dunkard sand to bottom and dry	1223 to	1254

About 1 mile and ¾ths due east of Big Moses P. O. there occur 4 or 5 **Maxton sand** oil wells on the eastern flank of the Big Moses anticline. The two following well records in this pool are of interest:

C. J. Allen No. 1 Well Record (T 142), McElroy District.

Located 1 mile and ¾ths due east of Big Moses P. O. Authority, American Oil and Development Co.

	Feet.	Feet.
Coal, Pittsburg	760	
Cow Run sand	1140	
Salt sand	1560	
Maxton sand	1922 to	1943
Oil pay	1929 to	1943
Total depth		1958

Production first 24 hours, 25 bbls.
Graded as amber oil but is dark and heavy.

C. J. Allen No. 2 Well Record (T 143), McElroy District.

Located 1 mile and ¾ths due east of Big Moses P. O. Authority, American Oil & Development Co.

	Feet.	Feet.
Coal, Pittsburg	790	
Cow Run sand	1140	
Salt sand	1560	

	Top	Bottom
Maxton sand	1948 to	1955
Oil pay	1948	
Total depth		1968

Made only 2 or 3 bbls. Was turned over to the Philadelphia Co. which drilled it to the Gordon and deeper. Was dry and abandoned.

Extending southward from Indian creek along the eastern slope of the Big Moses arch in the rocks to the mouth of Flint run of McElroy creek at the Tyler-Doddridge county line there occurs a large number of Big Injun sand oil wells. The records of the following wells, two in number, give the stratification in this field:

David Underwood No. 19 Well Record (T 167), McElroy

Located on Davis run of McElroy creek, ½ mile N. of Little Pittsburg. Authority, South Penn Oil Co. Completed Sept. 23, 1901.

	Feet.	Feet.
Coal, Pittsburg	470	
Big Injun sand	1763 to	1996
Oil and gas show, small	1870	
Gordon Stray sand	2514	
Gordon sand	2530	
Oil show, small	2548	
Total depth		2605
Top of **Pittsburg coal** to **Big Injun sand**		1293
Top of **Pittsburg coal** to **Gordon Stray sand**		2044
Top of **Pitsburg coal** to **Gordon sand**		2060

David Underwood No. 20 Well Record (T 171), McElroy

Authority, South Penn Oil Co.

	Feet.	Feet.
Coal, Pittsburg (steel line)	605 to	610
Dunkard sand (steel line)	1048 to	1068
Salt sand (no water)	1425 to	1600
Maxton sand	1700 to	1740
Pencil cave	1835 to	1850
Big Injun sand (steel line)	1924	
Oil (steel line)	2018 to	2025
Total depth (steel line)		2041
Top of **Pittsburg coal** to **Dunkard sand**		443
Top of **Pittsburg coal** to **Salt sand**		820
Top of **Pittsburg coal** to **Maxton sand**		1095
Top of **Pittsburg coal** to **Big Injun sand**		1319

About 2 miles above Braden Station on Indian creek is found the great Stringtown oil field, located on what the

writer has termed the **Stringtown terrace** (see page 64) and northward along the foot of the eastern flank of the Big Moses anticline. The following is the record of the first well drilled in this field on the Indian creek side. This well was drilled in June, 1896 and is still producing oil:

J. L. McIntire No. 1 Well Record (T 184), McElroy District

Located on McIntyre fork in the east end of Stringtown. Authority, South Penn Oil Co.

	Feet.	Feet.
Coal, Pittsburg	624	
Big Injun sand	1945	
Oil show at	2034	
Gordon sand	2692 to	2710
Oil at	2702	
Total depth		2716
		Feet.
Top of **Pittsburg coal** to **Big Injun sand**		1321
Top of **Pittsburg coal** to **Gordon sand**		2068

Other well records of interest in this field are as follows:

Abner Wharton No. 1 Well Record (T 187), McElroy

On Indian creek, 1 mile N. E. of Stringtown. Authority, South Penn Oil Co.

	Feet.	Feet.
Coal, Pittsburg	652	
Big Injun sand	1962 to	2140
Oil show	2055	
Gordon Stray sand	2686 to	2708
Oil	2698	
Gordon sand	2708 to	2733
Total depth		2753
		Feet.
Top of **Pittsburg coal** to **Big Injun sand**		1310
Top of **Pittsburg coal** to **Gordon Stray sand**		2034
Top of **Pittsburg coal** to **Gordon sand**		2056

A show of oil was found in the **Gordon Stray sand** as well as in the Big Injun in this well.

Alpheus Glover No. 4 Well Record (T 180), McElroy

Located on Stackpole run of Indian creek, 1 mile and ⅛th northwest of Stringtown (Alvy P. O.). Authority, South Penn Oil Co.

	Feet.	Feet.
Coal, Pittsburg	815	
Big Injun sand	2080 to	2210
Gordon Stray sand	2830 to	2843
Gordon sand	2855 to	2876
First oil pay	2873	
Total depth		2900

CENTERVILLE DISTRICT.

Centerville district lies south of Ellsworth and west of McElroy district, and its area is traversed by one prominent structural fold; viz., the Middlebourne syncline, passing through its western portion in a northeast-southwest direction. Most of its eastern area lies on the gentle western slope of the Big Moses anticline, and in this part of the district there occur three small separate and distinct oil fields.

The first of these pools is what is known as the **Klondike field,** located on the head of Pitts run, about 2 miles northwest of Centerville (Alma P. O.). This pool is situated on the Centerville-Ellsworth district line, the latter dividing the field into about two equal parts. The oil occurs in the Big Injun sand.

Jas. A. Meredith No. 1 Well Record (T 189), Centerville Authority, South Penn Oil Co.

	Top Feet.
Coal, Pittsburg?, blossom (Sewickley)	795
Sand, with water	800
Little Dunkard sand	1300
Big Dunkard sand	1410
Salt sand	1570
Maxton sand	1965
Big Injun sand	2141
Oil	2186
Total depth	2198

Produced 400 bbls. per day at first from the Big Injun sand. Now abandoned.

The coal blossom at 795 feet, identified by the driller as the Pittsburg bed must represent the Sewickley or possibly the Redstone. The record of the following dry hole located ½ mile northeast in the edge of Ellsworth district

gives the Pittsburg-coal-Keener sand interval as only 1264 feet:

Wm. Morris No. 1 Well Record (T 113), Ellsworth District.

Located 2 miles northwest of Centerville (Alma P. O.). Authority, American Oil & Development Co.

	Top. Feet.	Thickness. Feet.
Coal, Pittsburg	520	
Cow Run sand? **(Dunkard)**	985	
Maxton sand	1646	
Big Lime	1681	80
Keener sand to bottom	1784	96
Dry hole.		
Top of **Pittsburg coal** to **Dunkard sand**		465
Top of **Pittsburg coal** to **Maxton sand**		1126
Top of **Pttsburg coal** to **Keener sand**		1264

The second oil pool in Centerville district is located on Conaway run, ¾ mile south of Centerville (Alma P. O.). The following records of two wells give the succession of the strata in this field:

A. W. Duty No. 3 Well Record (T 195), Centerville District.

Located on Conaway run, 9-10ths mile S. 10° E. of Centerville, (Alma P. O.). Authority, Carter Oil Co.

749′ L—A. T.

	Feet.		Feet.
Cave	830	to	890
Cow Run sand	900	to	920
Salt sand	1040	to	1153
Maxton sand	1570	to	1610
Big Lime	1665	to	1737
Keener sand	1737	to	1752
Big Injun sand	....		
Oil at	1810		
Total depth			1854

The depth to the top of the **Big Injun sand** is not recorded but it is evidently the oil horizon in this field.

S. C. Wilcox No. 2 Well Record (T 193), Centerville District.

Located on Conaway run, 1 mile and a third southwest of Centerville (Alma P. O.). Authority, Carter Oil Co. Completed Feb. 2, 1899.

	Feet.		Feet.
Cave	600	to	870
Cow Run sand **(Dunkard)**	1015	to	1040

Salt sand	1170 to 1395
Maxton sand	1635 to 1665
Big Lime	1690 to 1760
Keener sand (no good)	1760 to 1791
Big Injun sand (no good)	1791 to 1885
Total depth	1885

The **Pittsburg coal** horizon belongs at about 500 feet in this well, and the sand identified by the driller as the Cow Run, is the **Dunkard** or Mahoning sandstone of the Conemaugh series.

The third oil pool in Centerville district is located near the head of Purgatory run of Middle Island creek, 2½ miles southwest of Centerville (Alma P. O.). The following record of the A. L. Corbly No. 5, well shows the succession in this portion of Centerville district:

A. L. Corbly No. 5 Well Record (T 196), Centerville District.

Located 2.7 miles southwest of Centerville. Authority, Carter Oil Co.

	Feet.	Feet.
Cow Run sand (**Dunkard**)	920 to	940
Salt sand	1000 to	1300
Big Lime	1690 to	1757
Big Injun sand to bottom of hole	1757 to	1838
Gas pay, light	1780 to	1790

The following is the record of a dry hole drilled in the northwest corner of Centerville district:

J. P. Mason No. 1 Well Record (T 191), Centerville District.

Located on head of Foster run of Sancho creek, 2 miles due east of Sancho P. O. Authority, Melrose Oil Co.

	Top. Feet	Thickness. Feet.
Water	18	
Hurry-Up sand	280	40
I Cow Run sand	775	35
Salt sand	923	517
Maxton sand?	1470	80
Big Lime	1695	85
Keener sand	1780	40
Gas pay at	1785	
Break	1820	10
Big Injun sand	1830	65
Break	1895	17
Squaw sand	1912	23
Total depth	1949	

The Pittsburg coal horizon belongs at near 530 feet: hence the following intervals:

	Feet.
Top of **Pittsburg coal** to **I Cow Run sand**	245
Top of **Pittsburg coal** to **Maxton? sand**	940
Top of **Pttsburg coal** to **Keener sand**	1250
Top of **Pittsburg coal** to **Big Injun sand**	1300
Top of **Pittsburg coal** to **Squaw sand**	1382

A light show of gas was encountered in the Keener sand.

About ⅓ mile due south of the J. P. Mason No. 1. well (T 191), the Carter Oil Co. brought in a small oil well from the **Big Injun** sand on the Jas. Mason farm (T 192). This well made about 5 bbls. of oil daily for two or three months, but was finally abandoned. The chances are possible that this oil showing is an extention of the Klondike field, located two miles to the northeast, since the Big Injun sand is the producing horizon of the latter pool.

In the extreme western portion of the district two gas wells have been drilled on the head of Sancho, south of Bearsville; viz., Jacob S. Hamilton (T 203) and B. L. Pyle No. 1 (T 204). The very complete detailed record of the latter is published on page 332.

The following is the record of a well drilled on Little Camp Mistake run, about midway between Josephs Mills and Wilbur:

John Mercer No. 1 Well Record (T 198), Centerville District

Located 1 Mile due west from Wilbur. Authority, South Penn Oil Co. Completed Dec. 18, 1897.

	Top. Feet.
Coal, Uniontown	142
Coal, Pittsburg	400
Fresh water	1200
Salt sand? **(Maxton)**	1540
Big Injun sand	1686
Gas pay at	1686
Gas pay at	1776
Gas pay at	1786
Total depth	1841
Top of **Pittsburg coal** to **Maxton sand**	1140
Top of **Pittsburg coal** to **Big Injun sand**	1286

The **Washington coal** crops 62 feet (hand-level measurement) above the well mouth, giving the **Washington coal—Pittsburg coal** interval as 462 feet in this portion of Tyler county.

One mile southwest of Josephs Mills, the Centerville Oil and Gas Co. drilled a well to a depth of 1740 feet on the David W. Hess farm (T 199). A showing of gas was encountered in the Big Injun sand. The Washington coal (3 feet thick) was struck at a depth of 23 feet. According to the interval given in the Mercer well above, the **Pittsburg coal** horizon should belong at near 585 feet, or 462 feet below the Washington bed, hence the authority for drawing the 350-foot structure contour on the Pittsburg coal to the west of this well.

In the extreme southern point of Tyler county, and of Centerville district as well, two dry holes have been drilled west and southwest of the town of Deep Valley; viz., on the Alf Conaway (T 200) and L. D. Cain (T 201) farms. The writer was unable to obtain any log of these wells, but the following record of a well, located just across the Doddridge county line on Long run of Arnolds creek, shows the succession of strata for the extreme southern point of Tyler.

Finley Dotson No. 1 Well Record (T 202), Center District, Doddridge County.

Located one mile and a half due south of Deep Valley. Authority, Carter Oil Co.

	Feet.		Feet.
Coal, Pittsburg, poor	393	to	394
Cave	640	to	910
Cow Run sand **(Dunkard)**	910	to	940
Salt? sand **(II Cow Run)**	1135	to	1265
Salt sand	1340	to	1500
Oil show at 1446'.			
Cave, bad	1640	to	1655
Big Lime, poor	1655	to	1698
Big Injun sand	1698	to	1815
Gas show at 1698' and 1815'.			
Total depth			1884
Considered dry and abandoned			
Top of **Pittsburg coal** to **Dunkard sand**			517
Top of **Pittsburg coal** to **II Cow Run sand**			742
Top of **Pittsburg coal** to **Salt sand**			947
Top of **Pittsburg coal** to **Big Injun sand**			1305

MEADE DISTRICT.

Meade district lies west of Centerville and south of Ellsworth and Union districts. Its area is traversed by two structural folds; viz., the Middlebourne syncline and the Wick anticline. A great oil field extends along the eastern slope of the latter arch in the rocks from Little Sancho creek southwestward to the Tyler-Pleasants county line; and also along the western slope of the same arch from Falls Mills southward to Hebron. The logs of the two following dry holes give the succession of the strata in the northern part of Meade District:

Mary Ash No. 1 Well Record (T 208), Mead District.

Located on Foster run of Sancho creek, 1 Mile N. E. of Sancho P. O. Authority, Carter Oil Co.

	Feet.		Feet.
Cave	830	to	850
II Cow Run sand	1165	to	1200
Maxton sand	1420	to	1490
Big Lime	1615	to	1700
Keener sand	1700	to	1715
Big Injun sand (oil show at 1719')	1719	to	1820
Squaw sand	1848	to	1855
Unrecorded to bottom	1855	to	1891

Jas. Ash No. 1 Well Record (T 210), Meade District.

Located on Little Sancho creek, 1 mile and ⅔rds N. W. of Sancho P. O. Authority, Carter Oil Co.

	Feet.		Feet.
Coal, Pittsburg (6" thick)	380	to	
Cow Run? sand **(Dunkard)**	800	to	830
Salt? sand **(Lower Freeport)**	900		
Big Lime	1500	to	1625
Break of slate	1625	to	1630
Big Injun sand to bottom of hole	1630	to	1675
First oil pay at	1630		
Second oil pay at	1670		

	Feet.
Top of **Pittsburg coal** to **Dunkard sand**	420
Top of **Pittsburg coal** to **Lower Freeport sand**	520
Top of **Pittsburg coal** to **Big Injun sand**	1250

The following is the record of another well 1 mile west from the Jas. Ash No. 1 (T 210):

W. R. Gorrell No. 1 Well Record (T 211), Meade District.

Located on Little Sancho creek, 1/8th mile N. W. of Bert P. O. Authority, Carter Oil Co.

	Feet.		Feet.
Coal, Pittsburg, poor	400	to	403
Cave, bad (Big Reds)	650		
Cow Run sand, poor (Dunkard)	890	to	920
Salt sand	940	to	1240
Maxton sand, (gas, 1535')	1520	to	1560
Big Lime, regular	1600	to	1660
Keener sand	1660		
Big Injun sand to bottom of hole	1696	to	1821
Dry hole, except Maxton sand gas showing.			
Top of Pittsburg coal to Dunkard sand			490
Top of Pittsburg coal to Maxton sand			1120
Top of Pittsburg coal to Keener sand			1260
Top of Pittsburg coal to Big Injun sand			1296

The driller has evidently identified as Salt sand all the sandy beds from the top of the Lower Freeport sandstone down to the base of the Pottsville series. The elevation of the top of the hole is 805 feet A. T., giving the tidal elevation of the top of the Pittsburg coal as 405 feet A. T. This well along with the following record of a well farther up Little Sancho creek is authority for the 400-foot structure contour on the Pittsburg coal (See economic geology map) through Bert P. O.

J. J. Gorrell No. 1 Well Record (T 212), Meade District.

Authority, Carter Oil Co. Completed April 28, 1903.

	Feet.		Feet.
Coal, Pittsburg?, poor (Sewickley)	450	to	453
Cave, bad	465	to	765
Cow Run sand, poor	765	to	800
Salt sand	1065	to	1365
Maxton sand (water at 1645')	1635	to	1655
Big Lime	1660	to	1731
Keener sand	1731	to	....
Big Injun sand (gas at 1795', poor)	1763	to	1863
Total depth (dry)			1863

On the head of Freeland run, 3/4th mile N. W. of Sancho P. O. there occurs a field of 25 or 30 oil wells in the Big Injun sand. The following record is from a well in this field:

John Loneberger, No. 5 Well Record (217), Meade District.

Located ½ mile N. W. of Sancho P. O. on Freeland run of Sancho creek. Authority, Carter Oil Co.

	Feet.		Feet.
Coal, Pittsburg? (Uniontown)	198	to	200
Cave	660	to	800
I Cow Run sand	800	to	840
Cow Run sand (Lower Freeport)	890	to	925
Salt sand? (II Cow Run)	1100	to	1122
First Salt sand	1160	to	1214
Second Salt sand	1275	to	1380
Little Lime	1530	to	1555
Big Lime	1610	to	1656
Keener sand	1656	to	1694
Big Injun sand	1694	to	1794
Oil pay	1739	to	1742

The driller has wrongly identified the **Uniontown coal** for the **Pittsburg** bed, the latter belonging at near 400 feet. The following record of a well located slightly over a mile southwest of the Loneberger (T 217) boring, gives the true horizon of the Pittsburg coal:

E. B. Long No. 8 Well Record (T 220), Meade District.

Located 1 mile and 6-10ths east of Wick. Authority, Carter Oil Co.

	Feet.		Feet.
Coal, Pittsburg	575	to	580
I Cow Run sand (water at 925')	925	to	945
Cow Run sand (**Dunkard**)	983	to	1003
Salt sand	1260	to	1362
Salt sand (water at 1370')	1370	to	1410
Salt sand	1430	to	1470
Maxton sand	1675	to	1695
Lime	1739	to	1811
Keener sand	1811	to	1822
Big Injun sand	1828		
Total depth			1887
Oil and gas at 1861'; water at 1840' and 1880'.			
Top of **Pittsburg coal** to **I Cow Run sand**			350
Top of **Pittsburg coal** to **Dunkard sand**			408
Top of **Pittsburg coal** to **Maxton sand**			1100
Top of **Pittsburg coal** to **Keener sand**			1236
Top of **Pittsburg coal** to **Big Injun sand**			1253

This well is located near the northeast extention of the rich Big Injun sand oil pool along the eastern slope of the Wick anticline.

Carse Heirs No. 6 Well Record (T 222), Meade District.

Located ½ mile south of Long No. 8 (T 220) and 2

miles N. 10°-15° E. of McKim P. O. Authority, Carter Oil Co. Completed, March 8, 1906.

	Feet.		Feet.
Coal, Uniontown	349	to	355
Cave	780	to	905
I Cow Run sand	905	to	935
Cave	935	to	1055
Salt sand	1220	to	1335
Salt sand	1395	to	1465
Maxton sand	1600	to	1650
Big Lime	1750	to	1820
Keener sand	1820	to	1845
Big Injun sand	1853	to	1905
Oil and gas	1872	to	1884
Total depth			1960

The **Pittsburg Coal** horizon belongs at near 585 feet.

The following is the record of the largest oil well in this great field, a photograph of which appears on another page. Oil was encountered at the bottom of the Keener sand, but the best pay was 3 feet in the main bed of the Big Injun sand:

J. W. Ankrom No. 6 Well Record (T 226), Meade District. Authority, Carter Oil Co.

	Feet.		Feet.
Coal Uniontown	370	to	372
Cave	702	to	952
Cow Run sand (Dunkard)	1030	to	1080
Salt sand (**Dunkard**)	1150	to	1170
Salt sand (**Lower Freeport**)	1190	to	1300
Salt sand (water at 1425')	1320	to	1465
Maxton sand	1575	to	1615
Limestone	1740	to	1835
Keener sand (oil at 1870')	1835	to	1870
Big Injun sand, gas at 1875', oil at1887'	1875		

Biggest well in field. Started off at 100 bbls. per hour. Very little salt water in Big Injun sand.

In the vicinity of McKim P. O. there occurs a large I Cow Run sand oil pool on the Poe, Broadwater and other farms. This producing sand comes 350 to 400 feet below the Pittsburg coal and 525 to 575 feet below the **Uniontown** bed. The following records show its horizon as well as other data of interest:

Plate XII.—J. W. Ankrom No. 6, the Largest Big Injun Sand Oil Well in the McKim Field, Tyler County (Seet Text).

J. L. Poe No. 6 Well Record (T 233), Meade District.

Located ¾ mile N. W. of McKim P. O. Authority, Carter Oil Co. Completed Oct. 12, 1901.

	Feet.		Feet.
Cave, soft	770	to	940
I Cow Run sand, good and soft	1050	to	1081
150 bbl. well at 1052'.			
Total depth			1081

This well was completed in October, 1901, and is still making 10 to 12 barrels daily, being probably the best well in the field.

H. D. Owens No. 3 Well Record (T 236), Meade District.

Located ¾ mile N. 15°-20° E. of McKim P. O. Authority, Carter Oil Co. Completed Oct. 7, 1906.

	Feet.		Feet.
Coal, Uniontown	365	to	367
Cave	755	to	810
Cow Run? sand (Morgantown)	875	to	880
I Cow Run sand **(Saltsburg)**	972	to	992
Oil pay	972	to	990
Total depth			992

The **Pittsburg coal** horizon belongs at near 620 to 630 feet.

A. Broadwater No. 48 Well Record (T 240), Meade District.

Located 1 mile and ¼ S. 15°-20° W. of McKim P. O. Authority, Carter Oil Co.

	Feet.		Feet.
Coal, Pittsburg? **(Uniontown)**	225	to	227
Cow Run sand? (Morgantown)	685	to	745
I Cow Run sand (Saltsburg)	825	to	850
Total depth (dry)			912

The Pittsburg coal horizon belongs 250 feet below the Uniontown at near 475 feet.

A. Broadwater No. 47 Well Record (T 243), Meade District.

Located 1 mile and ⅓rd southwest of McKim P. O., on McKim creek. Authority, Carter Oil Co. Completed Aug. 23, 1903.

	Feet.		Feet.
Coal, Pittsburg?, no good **(Uniontown)**	240	to	243
Cave	680	to	755
I Cow Run sand	828	to	850
Oil, good	835	to	845
Total depth			850

The drillers, as a rule, identify the Uniontown coal in this region as the Pittsburg bed. The latter belongs at near 590 feet in the above well.

J. S. Riggs No. 2 Well Record (T 244), Meade District.

Located on McKim creek, ½ mile east of Plum P. O. Authority, Carter Oil Co.

	Feet.		Feet.
Coal, Pittsburg? (Uniontown)	230	to	232
Cow Run sand (Morgantown)	713	to	758
I Cow Run sand (oil at 857')	845	to	867
Total depth			878

The method of pumping wells in this field is illustrated on another page by a photograph of the above well.

O. W. O. Hardman No. 2 Well Record (T 231), Meade.

Located on ridge, 2 miles S. W. of Wick P. O. Authority, Carter Oil Co. Completed Nov. 23, 1905.

	Feet.		Feet.
Coal, Pittsburg? (Uniontown)	465	to	467
Cow Run? sand (Murphy)	960	to	995
I Cow Run sand (Saltsburg)	1077	to	1097
Oil pay	1080	to	1083
Total depth			1100

The Pittsburg coal horizon belongs at near 720 feet, hence the identificatoin by the writer in parenthesis.

The two following records are from wells located on the head of Rush fork of Sugar creek, 2 miles northwest of Wick. These records with slight additions by the writer were published by Dr. I. C. White in Vol. I (A), page 256, of the State Survey reports, as follows:

B. F. Robinson No. 1 Well Record (T 253).

Authority, Carter Oil Co.

	Feet.		Feet.
Coal (Macksburg) (Uniontown)	362	to	365
I Cow Run Sand	862	to	872
Salt Sand	1122	to	1422
Maxton Sand	1512	to	1562
Big Lime	1690	to	1765
Big Injun Sand	1800	to	1910
Total depth			1926

B. F. Robinson Well, No. 2. (T 254).

	Feet.	Feet.
Pittsburg Coal	700 to	703
I Cow Run Sand	1060 to	1075
Salt Sand	1250 to	1550
Maxton Sand	1825 to	1845
Big Lime	1850 to	1910
Big Injun Sand	1937 to	2057

"The records of these wells on the B. F. Robinson tract are of very great geologic interest and importance, since they reveal the interval (1,234 feet) between the Pittsburg coal and the main Big Injun oil sand, and also show that the coal found at 362 feet in the No. 1 well, is not the Pittsburg bed (as usually termed by the drillers of the region), but that it belongs approximately 200 feet above the Pittsburg bed, and is probably identical with the Macksburg coal of Ohio, or the Uniontown coal of the Monongahela formation. This coal appears to have a wide distribution in Tyler, Pleasants, Doddridge, etc., and may possibly be identical with the coal mined in the vicinity of St. Marys, immediately under a great ledge of sandstone, and which is identical with the Macksburg coal of Ohio. This bed has been referred by the Ohio geologists to the Sewickley horizon of the Monongahela formation, but it may possibly represent the Uniontown coal of the latter series, since its interval (200 feet) above the Pittsburg coal would appear to be too great for the Sewickley seam."

The following is the record of a Big Injun sand oil well, ½ mile northwest of the Robinson wells:

J. S. Wilson Estate No. 1 Well Record (T 256), Meade.

Located on head of Rush fork of Sugar creek, 2.3 miles N. W. of Wick. Authority, Carter Oil Co.

	Feet.	Feet.
Coal, Pittsburg, poor	535 to	538
Cave, bad	760 to	1060
Cow Run sand? poor (Dunkard)	1060 to	1075
Salt sand (water at 1420')	1190 to	1490
Maxton sand	1675 to	1705
Lime	1700 to	1760
Keener sand	1760	
Big Injun sand (oil) (water at 1852')	1802 to	1918

	Feet.
Top of Pittsburg coal to Dunkard sand	525
Top of Pittsburg coal to Maxton sand	1140
Top of Pittsburg coal to Keener sand	1225
Top of Pittsburg coal to Big Injun sand	1267

Clark Smith No. 1 Well Record (T 258), Meade District.

Located 1 mile S. W. of Falls Mills P. O. on Left fork of Allen run. Authority, Carter Oil Co. Completed Dec. 5, 1896.

	Feet.		Feet.
Coal, (Sewickley)	300	to	303
Coal, Pittsburg	360	to	365
Cow Run sand	765	to	795
Salt sand, broken			
Big Lime	1470	to	1575
Big Injun sand to bottom of hole	1575	to	1643
Keener sand (none)			
Little oil at	1598	to	1610
Gas pay at	1575		

Top of Pittsburg coal to Big Injun Sand 1215 feet

This is an important record in that both the Sewickley and Pittsburg coals are noted, something very unusual in Tyler conuty well records. The abbreviated records of several other wells in the McKim and Wick fields are found in the table of Tyler county wells on page 476.

EFFECT OF GEOLOGIC STRUCTURE ON OIL AND GAS DISTRIBUTION.

A study of the relation of the various oil and gas pools to geologic structure as shown on the economic geology map under a separate cover, will readily convince anyone that this feature has played no small part in segregating these valuable hydro-carbons into pools of commercial value. It can readily be seen by examining the map referred to, that by far the greater number of the gas wells occur along the crests of the anticlinal arches, or a short distance down from the axis on the slopes, and a good gas well is seldom found along or close to the axis of a syncline. The oil pools in most cases appear to range themselves along the flanks of the anticlines, or in structural terraces as seems to happen near Smithfield, Wetzel county, and the Stringtown and Elk fork regions of Tyler county. The Sistersville oil field, as

mentioned heretofore appears to be an exception to the general rule. There the oil is accompanied by vast quantities of salt water which has no doubt forced the oil up to the crest of the arch. About two miles northeast of Bowles Mills (Little P. O.), Tyler county, there occurs a narrow pool of Big Injun sand wells that crosses the axis of the Shiloh syncline almost at right angles. This appears to be an exception to the **anticlinal theory** of the accumulation of oil and gas. However, in this particular region the well records were so incomplete and definitely recognizable **key rocks** so concealed that the writer is not at all certain of the structure there as outlined on the map.

PROSPECTIVE OIL AND GAS TERRITORY.

On preceding pages of this report along with the descriptions of the various fields by magisterial districts, the wirter has given a few hints in regard to the further development of the oil and gas fields for that particular region. Marshall, Wetzel, and Tyler counties have been pretty thoroughly drilled over, yet it is possible and quite probable that there still remain undiscovered oil and gas pools within the areas. It is quite hazardous to suggest just where such pools might occur, but the oil and gas operators will no doubt be greatly aided in their search for this product by the accurate map of the three counties accompanying this report, showing all the oil and gas wells, and dry holes, as well as a fairly accurate structure map, exhibiting approximately the amount and direction of the dip of the rocks at all points of the area.

CHAPTER IX.

THE COAL RESOURCES OF THE MARSHALL-WETZEL-TYLER AREA.

The geology, structure and character of all the coals of the Marshall-Wetzel-Tyler area have already been described in detail on preceding pages of this report, and the purpose of this chapter is to take up the coal production, and the chemical composition and character more in detail of the workable beds, as well as the possible available area of the latter left unmined. The coals in the area under discussion include a very small proportion of the Appalachian field which is made up of the following areas[1]:

	Sq. miles.
West Virginia[2]	12,930?
Pennsylvania	11,850
Ohio	8,400
Kentucky	7,300
Tennessee	2,068
Alabama	3,740
Georgia	24
Virginia	1,480
Maryland	408
Total	48,200

1. U. S. Geol. Survey, Mineral Resources.

2. In a recent address before the American Mining Congress at Pittsburg, Pa., Dr. I. C. White, State Geologist, gave the total area of first class available fuel in West Virginia at only about 8,500 square miles.

Statistics of Coal Production.

In the Marshall-Wetzel-Tyler area, mining of coal on a commercial scale has been confined entirely to the Pittsburg bed. As brought out on preceding pages of this report, the Pittsburg coal horizon lies deeply buried below drainage over the entire area under discussion, except along the Ohio river front of Marshall county. Hence the only commercial mines are found in the latter area, and the statistics tabulated by the State Mine Department of course give no data for Wetzel and Tyler counties.

The following table was compiled by the writer from the Annual Report of the Department of Mines of West Virginia for the year ending June 30, 1908, by Hon. J. W. Paul, Chief:

Table Showing the Coal Production of Marshall County from 1888 to 1908 inclusive.

Year.	Tons of 2240 lbs.	Year	Tons of 2240 lbs
1888.....	59,172	1899.....	233,800
1889.....	84,606	1900.....	242,176
1890.....	110,418	1901.....	199,633
1891.....	118,242	1902.....	201,179
1892.....	166,893	1903.....	279,276
1893.....	110,530	1904.....	345,273
1894.....	84,037	1905.....	380,666
1895.....	137,762	1906.....	411,061
1896.....	148,128	1907.....	560,427
1897.....	162,396	1908.....	369,189
1898.....	165,874	Total.....	4,570,738

According to the same report referred to above the following table shows the relative rank of Marshall county as compared to other counties of the State:

Order in the Production of Coal, 1897-1908.

Counties	1897	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908
Fayette	1	1	1	1	1	1	2	1	2	2	2	2
McDowell	2	2	2	2	2	2	1	2	1	1	1	1
Marion	3	3	3	3	3	3	3	4	3	4	4	4
Kanawha	4	4	4	4	4	4	5	3	4	3	3	3
Mercer	5	5	5	6	6	6	6	6	6	6	6	6
Harrison	9	9	8	7	5	5	4	5	5	5	5	5
Tucker	6	6	7	5	7	7	7	8	8	8	10	10
Mingo	8	8	9	9	9	8	8	7	7	7	7	7
Mineral	7	7	6	8	8	9	11	11	12	13	14	13
Preston	13	11	10	10	10	10	9	10	10	9	9	11
Taylor	10	10	11	11	11	11	14	16	16	16	17	17
Marshall	**11**	**12**	**12**	**12**	**13**	**16**	**13**	**14**	**14**	**15**	**15**	**18**
Randolph	....	....	....	14	14	14	12	13	13	12	13	14
Barbour	19	19	17	18	12	12	10	9	11	11	11	12
Raleigh	16	16	16	19	17	13	15	12	9	10	8	8
Putnam	12	13	13	13	15	15	16	15	15	14	18	16
Ohio	15	15	14	15	16	17	18	19	21	22	21	21
Brooke	17	18	18	20	20	20	23	22	17	17	16	15
Mason	14	14	15	16	18	19	19	20	22	21	22	22
Grant	....	....	....	..	....	....	22	18	19	19	20	20
Logan	....	....	....	....	....	....	....	....	20	18	12	9
Monongalia	20	17	19	17	19	18	17	17	18	20	19	19
Hancock	18	20	20	21	21	21	20	21	24	24	23	25
Clay	....	....	....	....	....	....	....	25	23	23	24	27
Nicholas	....	....	....	....	....	22	24	24	25	25	25	26
Lincoln	....	....	....	....	....	23	21	23	27	26	30	30
Braxton	....	....	....	....	....	....	....	....	....	....	26	23
Wayne	....	....	....	....	....	....	....	....	26	27	29	29
Upshur	....	....	....	....	....	....	....	....	....	28	27	24
Greenbrier	....	....	....	....	....	....	....	....	....	....	28	28
Lewis	....	....	....	....	....	....	....	....	....	....	31	31
Gilmer	....	....	....	....	....	....	....	....	....	....	32	32
Wyoming	....	....	....	....	....	....	....	....	....	....	....	33

The following table, compiled from the same report, page 11, as referred to above gives the coal production of Marshall county by mines as follows:

Production of Coal for Year Ending June 30, 1908.

Reference No.	Name of Company	Name of Mine	Production	Distribution, Tons of 2240 Pounds		
			Tons of 2240 Pounds	Used in operation of mine	Furnished local Trade and Tenants	Shipped from mine
1	Hitchman C. & C Co.....	Hitchman..	226,809	2,142	3,677	220,990
2	Boggs Run Min. & M'f'g. Co....	Boggs Run	32,679	445	4,911	27,323
3	Wheeling Steel & Iron Co.....	Benwood Mill	53,125	.....	*53,125	.....
4	Glendale Coal Co.	Glendale ..	33,945	1,784	1,173	30,988
5	Mound Coal Co.	Mound ...	18,089	60	2,571	15,458
6	Panama C. M. Co.	Panama ..	2,499	712	518	1,269
7	Bituminous Coal Co. of America.	Bituminous No. 1	2,043	669	736	638
	Totals	.....	369,189	5,812	66,711	296,666

* Used in mill.

The following table, compiled from the same report referred to above, gives important data as to labor employed at each of the mines referred to above. Reference numbers for mines are the same in each table:

Detail of the Men Employed at the Mines of Marshall county for the year ending June 30, 1908.

Reference No.	EMPLOYEES							Average number of days mines were operated	No. of Horses and Mules Inside
	Inside					Outside			
	Pick Miners	Machine Miners	Machine Runners and Helpers	Laborers	Total	Laborers	Sum Total		
1.	.....	170	24	30	224	26	250	216	16
2.	40	.....	.....	12	52	8	60	190	5
3.	10	54	6	15	85	11	96	172	3
4.	.....	30	8	15	53	12	65	165	7
5.	6	15	4	8	33	4	37	211	4
6.	20	.....	.....	4	24	4	28	.....	4
7.	.....	11	2	3	16	6	22	150	.....
Totals:	76	280	44	87	487	71	558	196	39

COALS OF THE MARSHALL-WETZEL-TYLER AREA.

There are seven workable coals in the area under discussion in addition to nine other seams which are too thin to be of any economic importance. The most important beds are the Pittsburg, Sewickley, Waynesburg, and Washington, along with the lesser beds, Uniontown, Waynesburg, "A", and Lower Freeport. The diagram (Fig. 3) on the next page, shows the relative position of the persistent coals in the three counties. At the present time, as mentioned heretofore, only the Pittsburg coal is worked along the railroads on a commercial scale. The Sewickley, Waynesburg, Washington, and Waynesburg "A" have been opened and mined for local domestic use by farmers. The various veins, practically undeveloped back from the Ohio river front of Marshall county, and there only the Pittsburg bed, represent a great supply of valuable fuel, and one of the richest assets of Marshall and Wetzel counties.

The general descripttion and stratigraphy of these coals has already been given on preceding pages, while the chemical composition, heating value, and detailed structure of the beds at the various mines, commercial and local domestic, form the subject of this chapter.

The chemical analyses and determination of heating values, given on subsequent pages, were made by Mr. Leicester Patton, and J. Berghius Krak, Assistant Chemists of the Survey under the supervision of Prof. B. H. Hite, Chief Chemist. The coals were sampled by the writer and where possible a sample was obtained by digging down a section of the coal entirely across the fact of the bed, excluding only such slates and partings as are taken out in mining operations. In the commercial mines, these samples were crushed and quartered down to two or three pounds of coal, placed in tin cans, hermetically sealed and sent to the laboratory of the Survery. The same methods of analysis were used as by the Fuel Testing Department of the U. S. Geological Survey.

The calorific value of the coals analyzed for this report

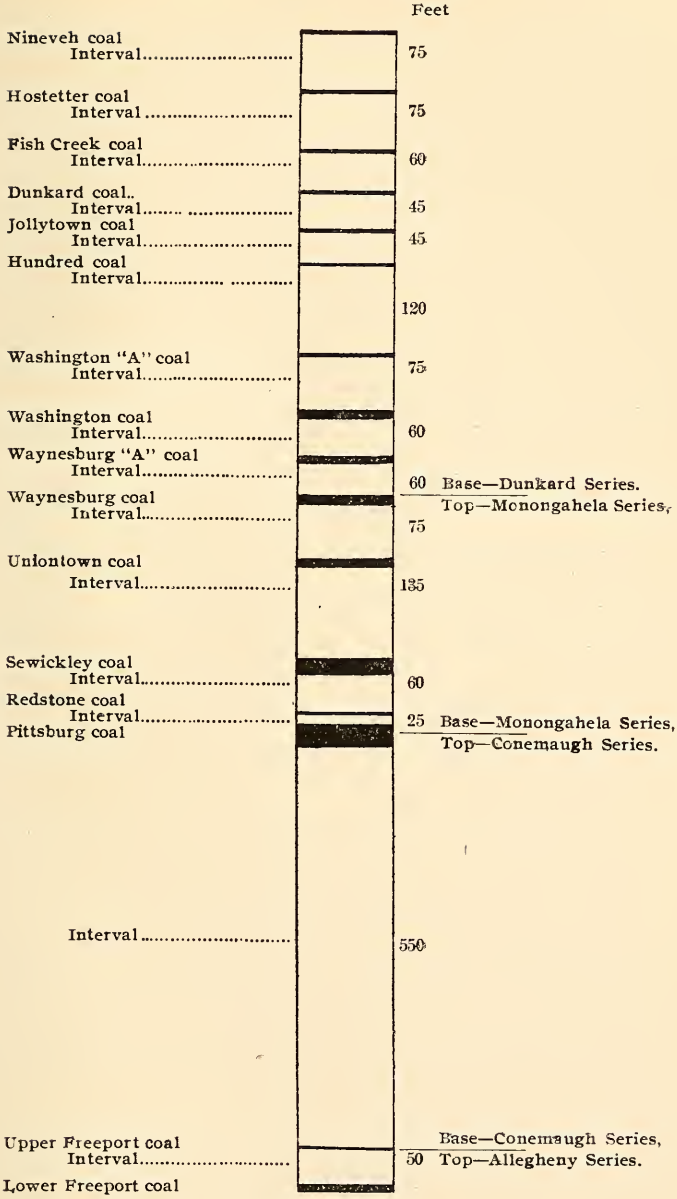

Fig. 3. Diagram showing the relative position of the coals in the Marshall-Wetzel-Tyler area.

is expressed in terms of British Thermal Units, the unit of heat measurement more commonly used in the United States. This unit of heat measurement, usually marked B. T. U., represents the amount of heat required to raise one pound of water one degree Fahrenheit in temperature.

In any analysis giving the B. T. U. result, the number of heat units given represents the amount stored up in one pound of the coal. For instance, the table of coal analyses following page 577, shows the Fish Creek coal (Laboratory No. 353-H) containing 13,018 B. T. U. for one pound of coal. The Pittsburg coal bed in the Fairmont, W. Va., region runs from 14,000 to 14,400 B. T. U. for each pound of coal, and the New River-Pocahontas coals run about 1000 B. T. U. higher.

Along with both the proximate and ultimate analysis is also given the B. T. U. result as well as the ratio of the total carbon to the oxygen plus ash. It has only recently been insisted upon that oxygen has about the same deteriorating effect as ash in a coal and the above mentioned ratio, proposed by Mr. David White[3] of the National Museum and U. S. Geol. Survey, is the best yet devised for the classification of coals in order to show their relative rank.

The coals of the three counties will now be described in descending order:

THE COALS OF THE DUNKARD SERIES

The Washington Coal.

The highest workable coal of the Dunkard series in the Marshall-Wetzel-Tyler area is the Washington bed, a detailed description of which is found on page 221. This seam is the most persistent coal of the entire area, and the most valuable bed in Tyler county. The outcrop of this coal is shown on the economic geology map accompanying this report in a separate cover. The outcrop as there outlined on the map shows where this coal is easily available to drift

3. See "Science" N. S., Vol. XXVII, No. 692, pp 537-538, Apr. 13, 1908.

openings as well as where it passes below drainage on the principal streams.

Along Wheeling creek in northern Marshall county, this coal outcrops in the hills 110 to 120 feet over the Waynesburg bed. The section given for Viola on page 223, shows its character and thickness along this valley. The farmers have not mined it to any extent for local domestic fuel, but have depended more on the Waynesburg coal below.

Along the Ohio river front of Marshall, its blossom is nearly always found along the hill roads leading eastward from the river, and in the southwestern part of the area this coal has become much more important from an economic standpoint than the Waynesburg bed. The following section on the C. Higgs farm shows its thickness and character along the hill road leading east from Franklin station:

	Feet.	Inches.
1. Coal, hard, blocky	0	6
2. Slate, gray	0	1
3. Coal, hard, blocky	3	0
4. Coal, slaty	0	6
5. Coal, hard, better to floor	1	5
Total	5	6

Here it is readily seen that the bed attains a good thickness.

Farther down the river in the extreme southwestern corner of the county and 2 miles northwest of Proctor, there occurs an old opening in this bed on the C. P. Wells farm where the writer measured the following sections, descending:

	Feet.	Inches.
1. Coal, slaty	3	0
2. Coal, good	1	6
Total	4	6

It has also been mined on the Abersold farm a short distance (½ mile) southwest of the Wells mine, but the opening had fallen in.

Its outcrop is also well exposed along Grave and Fish-

ing creeks, Marshall. It is well exposed in a cut along the B. & O. R. R. grade, ½ mile east of Robsys Rock. A section there is as follows descending:

		Feet.	Inches.
1.	Coal, slaty	1	10
2.	Shale, sandy with fossil plant, fragments in middle	11	6
3.	Coal	0	2
4	Slate	0	3
5.	Coal	0	9
	Total	14	6

The middle slate has apparently thickened up locally to 11½ feet. The coal passes below Grave creek near the first R. R. tunnel east of Rosbys Rock station. The Lynn Camp section on Fish creek on page 223 gives the thickness and structure of this coal on Fish creek in the southern central part of the county.

In Wetzel county the Washington coal was once quite generally mined for local domestic fuel by the farmers along Fishing creek and its tributaries.

Farther down the river to a point 3 miles southwest of New Martinsville. this bed has the following section:

		Feet	Inches.	
1.	Slate, black with streaks of coal	1	6	
2.	Coal	1	6	
	Total	3	0	(tidal elevation = 710')

The record of the Ed Wagner core test well (W 299) published on page 271. reports the Washington coal at a depth of 212½feet. The driller, Mr. M. J. O'Toole gave the writer the following detailed section of this bed in descending order:

		Feet	Inches.
1	Coal	0	6½
2	Slate, gray	0	1½
3	Coal, bony	0	3
4	Coal, good	2	0
	Total	2	11

The core of this coal as well as that for the Uniontown bed at a depth of 424′ 10″, was shipped to the Survey laboratory. Prof. B. H. Hite, Chief Chemist reports the following composition for both the upper and lower benches of the Washington coal in this test well:

Upper Bench.	Per cent.	Lower Bench.	Per cent.
Moisture	1.75	Moisture	1.68
Volatile Matter	29.63	Volatile Matter	36.05
Fixed Carbon	36.72	Fixed Carbon	47.87
Ash	31.90	Ash	14.40
Total	100.00	Total	100.00
	Per cent.		Per cent.
Sulphur	1.78	Sulphur	6.35
Phosphorus	0.008	Phosphorus	0.003

The upper bench is No. 1 of section and the lower bench is No. 4. The analysis bears out the character of the Washington coal wherever found in the area, in that the purest coal is found in the bottom portion of the bed.

Farther down Coal fork of Doolin run near its mouth, the Washington coal has been mined on the west side of the stream where the following section descending is exposed.

		Feet.	Inches.	
1.	Coal with streaks of slate	1	10	
2.	Slate, gray	0	2	
3.	Coal, better	1	8	
	Total	3	3	(720′ A. T.)

About 2 miles east of New Martinsville the Washington coal passes below drainage on Doolin run. Near this point there occurs an opening in this bed on the Elias Resseger farm where the writer measured the following section descending:

		Feet.	Inches.
1.	Coal	0	10
2.	Slate, with streaks of coal	0	4
3.	Coal, slaty	1	0
4.	Slate, gray	0	2
5.	Coal, good	2	0

A sample for analysis was selected from the stock pile near the mine, in which the coal was taken from No. 5 of section or bottom portion of the bed. The composition of this sample, including both proximate and ultimate analysis, as well as the B. T. U. result and the ratio of the total carbon to the oxygen plus ash, are all found in the table of analyses following page 577, under laboratory No. 391 H.

This coal was mined a great deal by farmers on Fishing creek before the development of the oil and gas fields and the construction of the Short Line Branch of the B. & O. R. R. along its valley. The following section was measured by the writer on this stream in an old opening located 2 miles southeast of New Martinsville at the north end of the loop where the creek makes a great bend to the north:

		Feet	Inches.
1.	Coal, slaty (upper bench)	1	9
2.	Slate, black	0	1
3.	Coal, good (lower bench)	1	10
	Total	3	8

The section here is nearly typical of the bed wherever found in Wetzel and Tyler counties. Passing up Fishing creek, the Washington coal is carried below the latter stream by the Loudenville (Finney) syncline before reaching the mouth of Little Fishing. The Washington anticline, however, elevates it above stream level one-third mile above the mouth of Fluharty run near Minnie station. At the mouth of Turkey run, 1 mile above Minnie, the lower bench of this coal has been mined by stripping out of the bed of the latter stream. A sample collected by J. W. Bonner of Minnie, W. Va., gave the results shown under Laboratory No. 390 H in the table of coal analyses following page 577.

The outcrop of this coal is well exposed at the west portal of the second R. R. tunnel east of Porters Falls where the following section was measured by the writer:

		Feet	Inches.
1.	Coal and slate mixed	0	10
2.	Shale, black	0	3
3.	Coal, slaty	2	2½
4.	Slate, 1" to	0	3
5.	Coal, good	1	9
	Total	5	3½

Practically the same section of the bed is exposed at the east portal of the first R. R. tunnel east of Porters Falls. In fact, it is reported that both tunnels were excavated through this bed throughout their entire length, the eastward rise of the rocks on the western flank of the Washington anticline keeping pace with the rise in grade of the railroad.

Passing on up Fishing creek to Reader its crop is exposed along the public road on the north side of the creek where its tidal elevation is 698 feet.

The following section of the Washington coal is exposed along the R. R. grade, 250 yards below the bridge over Piney fork:

		Feet.	Inches.	
1.	**Coal, slaty**	2	4	
2.	Sandstone	0	4	
3.	**Coal, good**	1	8	
	Total	4	4	(714′ A. T.)

Another section exposed along R. R. grade opposite the mouth of Shenango creek, one mile due west to Pine Grove, gives the following structure:

		Feet.	Inches.	
1.	**Coal, slaty**	1	0	
2.	Black slate	0	5	
3.	Coal, slaty	3	0	
4.	Slate, with streaks of coal	1	2	
	Total	5	7	(718′ A. T.)

A detailed section of this coal has already been given for Jacksonburg on page 224. The coal is dipping rapidly southeast at the latter point on the eastern flank of the Littleton anticline and is in the bed of Fishing creek, 8-10ths mile due east of the mouth of Richwood run.

The M. V. Anderson core test well (W 177), a short distance above, the record of which is published on page 276, reports 2 feet of **coal and slate** at 29′ 3″ in depth that represents the Washington bed.

The Jas. Shuman core test well (W 150) at Mobley P. O., the record of which is published on page 278, reports 15′ 5″ of **coaly slate, sandy shale, fire clay** and **coal** at the

horizon of the Washington bed, the whole not having much economic value.

In tyler county the Washington bed is the most persistent of all the coals. Along with the Waynesburg "A" seam it is the only coal that has been mined by the farmers for local domestic fuel. It has been mined mostly by stripping in stream beds, and the lower bench is generally preferred, the upper bench as a rule being much higher in ash and impurities.

On Buck run of Pt. Pleasant creek, 3½ miles N. 75° E of Sistersville, there occurs an opening in this bed on the Henry Buck farm. The coal was mined in a ravine where the full thickness was not exposed and only 10 to 12 inches of the lower bench available. The writer collected a sample for analysis at this place, the composition of which as reported by Prof. Hite is shown in the table of coal analyses, following page 577, under Laboratory No. 392 H. Its fuel ratio, (2.08), shows that it does not rank as high as other samples already given for the same bed in Wetzel county.

On Coallick run of Pt. Pleasant creek, 1 mile northeast of Kidwell, the Washington coal has been mined by stripping out of the bed of the run on the land of Jas. Eddy. Mr. C. R. Jobes gave the following section at this point:

		Feet.	Inches.	
1.	Clay	3	0	
2.	Slate, black 1" to	0	5	
3.	Coal, good 10" to	1	10	(775' A. T.)

The coal bed was concealed by water, but the writer obtained a freshly mined sample from the stock pile near by, the composition of which is given in the table of coal analyses following page 577 under Laboratory No. 397H. The B. T. U. result as well as the ratio (3.29) of the total carbon to the oxygen plus ash shows this sample to be a much better fuel than the one from Buck run above.

Farther south a good section of this coal is obtained where it crops along the public road near the north edge of Middlebourne, which is in descending order as follows:

		Feet.	Inches.	
1.	**Coal**	0	5	
2.	Gray and shale	1	1	
3.	**Coal**	1	8	
4.	Shale, gray and soft	0	1	
5.	**Coal**	0	5	
	Total	3	8	(750′ A. T.)

In the bed of Winze run of Sancho creek, 2.8 miles due south of Middlebourne, the Washington coal has been mined on the land of M. A. Buck. The bottom portion only, averaging about 18 inches in thickness, is mined. The writer collected a sample for analysis here, the composition of which is found under Laboratory No. 396 H in the table of coal analyses following page 577. This coal passes under Sancho creek about 1 mile below Bearsville.

The Washington coal is also exposed on the south side of the neck of the "Jug" where 15″ of coal is visible at an elevation of 750′ A. T. This coal has been mined at a great number of points by farmers farther up Middle Island creek and its tributaries in Tyler county; viz., on Muddy creek and Big run of Indian creek and Indian and McElroy creeks.

On Big run of Indian creek, 2.3 miles due north of Big Moses, the Washington coal has been opened up on the point at the mouth of Elder run on the land of F. M. McIntire heirs where it has the following structure according to Mr. A. F. Nichols who lives near by:

		Feet.	Inches.	
1.	**Coal,** slaty (top) 6″ to	0	8	
2	**Coal,** good 18″ to	2	0	(Bottom, 806′ L—A. T.)
	Total	2	8	

The face of the coal was concealed by water at this place.

On Woodburn run of Indian creek, 2¼ miles northeast of Big Moses P. O., this coal has been mined by stripping out of the bed of the stream on the land of Solomon Kile where it had the following section according to Mrs. Kile:

		Feet	Inches.	
1.	**Black slate** with 2 thin streaks of **coal** 4 ft. to	5	0	
2.	Coal, good 18" to	1	8	
	Total	6	8	(805' A. T.)

A massive sandstone (Lower Marrietta), 30 to 40 feet thick, crops 10 to 15 feet above this coal here. Several old abandoned openings occur in this bed on the south side of Indian creek opposite Booher P. O., where it comes 10 feet above the top of a great massive sandstone (Mannington) 40 to 50 feet thick. Farther up Indian creek at Braden Station the crop of this bed is exposed along the road and its section there is given on page 225.

On McElroy creek, one mile and a half N. 80° W. of Shirley, this bed has been opened up on the land of B. F. Reed at an elevation of about 840' A. T. The opening had fallen in, but Mr. G. M. Reed gave the following section for this mine:

		Feet	Inches.	
1.	**Coal,** slaty (top) 6" to	0	8	
2.	Slate, gray ½" to	0	1	
3.	**Coal,** good 18" to	1	8	
	Total	2	5	(840'B—A.T.)

Another opening occurs in this bed on the head of Pratt run, one mile and a quarter due east of Wilbur, where the writer measured the following section:

		Feet.	Inches.	
1.	**Black slate** (top)	5	0	
2.	**Coal, bony**	0	8	
3.	Slate, gray and hard	0	3	
4.	**Coal, good**	1	6	(Bottom, 868' L—A. T.)
	Total	7	5	

The Washington coal has been opened up on McElroy creek, opposite Little Pittsburg near the Tyler-Doddridge county line on the Ezekiel Pitts land. This opening had fallen in, but Mr. Pitts gave the following section for the bed:

		Feet	Inches.
1	**Coal, slaty** (top)	1	6
2.	Slate, gray	0	6
3.	Coal, good	1	6
	Total	3	6

On up Middle Island creek from the mouth of McElroy to the Tyler-Doddridge county line the Washington coal has been mined by farmers at several points for local domestic fuel. On page 225 is given a section of this bed near Camp P. O., on the Tyler-Doddridge county line on Camp Mistake run.

About one mile west of Deep Valley in the extreme southern part of Tyler county, there occurs an old abandoned opening in the Washington coal on the land of John Merritt. Mr. Moses V. Harter, living near by, gave the writer the following section at this mine:

		Feet.	Inches.
1.	Black shale	3	6
2.	**Coal, slaty** "hickory"	0	6
3.	Black shale	0	4
4.	Coal, good	1	6
	Total	5	10

In this portion of Tyler county the upper bench is called the "hickory" coal by the farmers.

On short run, one mile and a quarter southwest of Deep Valley, the writer measured the following section of this bed near the L. D. Cain No. 1 well (T 201):

		Feet	Inches.
1.	Coal, bony "hickory"	1	0
2.	Slate, gray and soft	0	2
3.	Coal, good 16" to	1	6
	Total	2	8

In the vicinity of Falls Mills and Bowles Mills (Little P. O.), Tyler county, the Washington coal appears to have thinned away and become of no economic importance, but farther northward near the head of Cow Hollow run, 2 miles due south of Sistersville, the writer measured the following section descending, of what appears to be the Washington coal at an old opening:

		Feet.	Inches.
1.	Coal	0	4
2.	Slate, gray	0	1
3.	Coal	0	3½
4.	Slate, gray and soft	0	1½
5.	Coal	2	0
6.	Slate, black	0	1
7.	Coal 8" to	0	9
	Total	3	8 (790' B. A. T.)

The coal was too much weathered to get a good sample.

In the turnpike section at Sistersville, pages 121-122, the Washington coal is shown to have a thickness there of 21″ to 24″, coming 42 feet above the "watering trough" coal (Waynesburg "A") and 403 feet above the Pittsburg bed

Quantity of Washington Coal Available.

In figuring up the coal resources of the Marshall-Wetzel-Tyler area the Washington coal must be considered. The average of 5 samples gives a fair idea of its composition, calorific value, and ratio of total carbon to oxygen plus ash as follows:

Proximate.	Per cent.	Ultimate.	Per cent.
Moisture	0.96	Carbon	65.48
Volatile Matter	34.73	Hydrogen	5.30
Fixed Carbon	47.43	Oxygen	7.55
Ash	16.88	Nitrogen	.85
		Sulphur	3.94
Total	100.00	Ash	16.88
		Total	100.00

	Per cent.
Sulphur	3.94
Phosphorus	0.008

Calorific Value:

Calorimeter B. T. U.	12,162
Calculated B. T. U.	12,382

$$\frac{\text{Carbon}}{\text{Oxygen} + \text{Ash}} = \frac{65.48}{7.55 + 16.88} = 2.67$$

As mentioned heretofore, it appears to be more persistent and regular than any other coal of the area, and in estimating the tonnage available for this bed, an average thickness of 24 inches does not seem excessive, on the assumption that the coal is present over the entire Marshall-Wetzel- Tyler area.

The following table of wells showing the depths and thickness to the Washington coal is of special interest in that 29 wells scattered over the area give an average recorded thickness of 3 feet for this bed:

Table of Wells Showing Depth to and Thickness of Washington Coal in the Three Counties.

No. on Map	Name of Well	District	County	Depth Feet	Thickness Feet
21	Upton Dorsey No. 1	Webster	Marshall	60	4
22	S. Lightner No. 1	Webster	Marshall	160	3
24	J. T. Cox No. 1	Webster	Marshall	140	2
4	Ed Francis No. 1	Washington	Marshall	115	3
65	Gartland Heirs No. 1	Liberty	Marshall	370	...
70	John Bruhn No. 7	Liberty	Marshall	648	3
43	Gorby Heirs No. 1	Meade	Marshall	634	4
47	Jennie Minor No. 1	Meade	Marshall	65	2
48	John W. West No. 1	Meade	Marshall	60	2
85	A. J. Fronaphel No. 2	Meade	Marshall	600	5
88	Gertrude Stein No. 1	Meade	Marshall	710	5
96	Ellen Fleming No. 1	Meade	Marshall	125	5
117	Gorby Heirs No. 1	Meade	Marshall	358	4
1	Sarah Anderson No. 1	Church	Wetzel	359	2
9	Jos. A. Phillips No. 1	Church	Wetzel	505	5
44	Geo. W. Thomas No. 1	Church	Wetzel	335	...
132	F. M. Watson No. 1	Grant	Wetzel	135	2
135	Letitia Lacox No. 1	Grant	Wetzel	158	2
136	D H. Cox No. 1	Grant	Wetzel	127	3
150	Shuman core test	Grant	Wetzel	103	...
177	M. V. Anderson core test	Grant	Wetzel	29	2
198	Blackshere Wells & Co. 5	Grant	Wetzel	140	5
214	Taylor Ruble No. 1	Grant	Wetzel	290	...
228	Brown core test	Green	Wetzel	130	2
268	Wm. Hart No. 1	Green	Wetzel	69	...
279	Geo. W. Cook No. 1	Proctor	Wetzel	125	...
280	J. A. Kocher No. 1	Proctor	Wetzel	82	...
290	H. R. Thompson No. 1	Proctor	Wetzel	726	4
295	Jacob Yoho No. 1	Proctor	Wetzel	400	2
299	Ed Wagner No. 1	Magnolia	Wetzel	220	4
300	Ed Wagner core test	Magnolia	Wetzel	212	3
78	T. J Farrell No. 1	Ellsworth	Tyler	80	2
79	Sarah McCormick No. 1	Ellsworth	Tyler	155	3
96	J. G. King No. 1	Ellsworth	Tyler	275	2
97	John King No. 2	Ellsworth	Tyler	123	1
100	David Hickman No. 1	Ellsworth	Tyler	50	1
103	K. S. Boreman No. 2	Ellsworth	Tyler	65	...
104	Mary Jemison No. 3	Ellsworth	Tyler	120	...
229	Moses Johnson No. 1	Meade	Tyler	315	...

Under column headed "Depth" in the above table, figures mean distance from top of hole and not depth below drainage. For tidal elevation of wells, see tabular list of abbreviated well words, pages 364, 404, and 476.

It is true that this coal is often 4 to 5 feet thick, but Wheeling, Little Grave, Middle Grave, Grave, Fish, Proctor,

Fishing, and Middle Island creeks and other tributaries, have eroded away large gashes from its original area. Hence an estimate of **one foot thickness** of available commercial coal for the bottom portion of the bed, and **one foot thickness** of available impure coal for the top portion, or a total of **two feet thickness** spread over the entire area appears conservative. Figuring on this basis we get the following results:

Table Showing Available Washington Coal in the Three Counties.

County.	Sq. Miles.	Acres.	Cubic Feet of both kinds of Coal.	Short Tons of both kinds of Coal.
Marshall	315.26	201,766.4	17,577,888,768	703,115,550
Wetzel	360.47	230,700.8	20,098,653,696	803,946,148
Tyler	260.12	166,476.8	14,503,458,816	580,138,352
Totals	935.85	598,944.0	52,180,001,280	2,087,200,050

The above table then gives the total available Washington coal in the three counties as follows:

	Short tons.
Impure coal	1,043,600,025
Commercial coal	1,043,600,025
Total	2,087,200,050

In obtaining the above results, it is assumed by the writer that 1 cubic foot of this coal weighs 80 pounds, or at the rate of 25 cu. ft. to the 2000 pound ton. These figures are the same as obtained for the weight of Pittsburg coal at the Fuel Testing Plant of the U. S. Geol. Survey at St. Louis, Mo.

Concerning this class of **impure coal**, Dr. I. C. White has the following to say in Vol. II (a), pages 693-694 of the State Survey reports:

"This grade of fuel is, of course, not now marketable, since its heat units can best be rendered available through the agency of producer gas and the gas engine which have not yet come into general use, although each ton of this impure coal when so utilized will produce more power, accord-

ing to the determinations of the Technologic Branch of the United States Geol. Survey, than a ton of the purest New River or Pocahontas coal, when the steam engine is the agency of conversion.

"When our best coals become more expensive to win, the State will have a large reserve of these poorer grades of fuel which will doubtless then be utilized for power and thus greatly prolong the life of West Virginia's coal fields, since, as may be observed from the details given in this volume, there is a large amount of impure coal so interstratified with the purer layers in nearly every mine, that its precious carbon is now utterly lost, because there is no market for impure coals."

THE COALS OF THE MONONGAHELA SERIES.

The Waynesburg Coal.

The Waynesburg coal caps the summit of the Monongahela series. A detailed description of the bed is found on page 282. This coal as a workable bed does not appear near so persistent in the Marshall-Wetzel-Tyler area as the Washington seam. The outcrop of the Waynesburg coal is shown on the economic geology map accompanying this report in a separate cover. Its horizon is rather indefinite along the Ohio river front from Powhatan station southward to Bens Run, Tyler county, and does not appear there to have any economic value.

As a possible workable bed its area appears to be confined to all the districts except Franklin of Marshall county, and Clay, Church, Center, northern Grant, and northeastern Proctor districts of Wetzel county. It does not seem to be of any economic importance whatever in Tyler county.

This coal has been mined quite a good deal by the farmers along Wheeling creek in northern Marshall county, for domestic fuel of which it produces a fair grade. As is the case with the Washington bed the lower bench of the Waynesburg coal is the purest portion of the seam.

This bed is easily accessible to drift openings along

Wheeling creek from where this stream enters Marshall county from the State of Pennsylvania to where it crosses the Marshall-Tyler county line as shown by its outcrop line on the map above mentioned, its interval above the bed of Wheeling creek ranging from 5 to 150 feet.

This coal has been opened up on the south side of Burches run of Wheeling creek, ⅓ mile up from the mouth of this stream, and its section there is given on page 285. The "big slate" parting, 9" thick, No. 2 of section, is characteristic of this bed in northern Marshall county, dividing the seam into two benches, termed, "upper" and "lower". The writer collected a sample from both benches for analysis here, the composition of which as reported by Prof. Hite is found under Laboratory No. 398-H in the table of coal analyses following page 577. Its fuel ratio (2.74) there shows it to rank slightly higher than the average (2.67) of 5 samples of Washington coal (see page 550.)

A short distance, ⅓ mile, below the mouth of Turkey run on the north side of Wheeling creek, the Waynesburg coal has been opened up on the land of Vincent Gray where the writer measured the following section:

		Feet	Inches.
1.	Coal, (upper bench) 12" to	1	1
2.	Slate, black	1	0
3.	Coal 0' 11"		
4.	Slate, black 0 1 (lower bench)	1	11
5.	Coal 8" to 0 11		
	Total	4	0

Separate samples for analysis were taken here by the writer from both benches, the composition of which as reported by Prof. Hite is found under Laboratory Nos. 400-H and 399-H in the table of coal analyses following page 577, for the upper and lower benches respectively. There the fuel ratios 2.17 and 2.60 show the relative rank of the two divisions of the bed. The upper bench appears much higher in sulphur and ash than the lower.

Another opening occurs in this bed on the south side of Wheeling creek a short distance, 100 yards, above Viola

P. O. on the Wm. L. Dague farm, where the writer measured the following section:

		Feet.	Inches
1.	Coal, with sulphur band 8" from top	1	10
2.	Slate, dark gray and hard	1	0
3.	Coal, bony	0	5
4.	Coal	1	7

The writer collected a sample for analysis from Nos. 1, 3, and 4 of section, the composition of which, as reported by Prof. Hite, is found under Laboratory No. 401-H in the table of coal analyses following page 577.

Several openings occur in this bed farther up Wheeling creek in one of which a section was measured by the writer and published on page 285. This bed has also been mined at Majorsville on the S. T. Alley farm where the following section was obtained:

		Feet.	Inches
1.	Coal, fair	1	6
2.	Gray shale	1	0
3.	Coal, visible	1	0
	Total	3	6

The writer was unable to obtain at this time a full section of the lower bench.

The outcrop of the Waynesburg coal is exposed at several points along the Ohio river front of Marshall county, north from Moundsville, but it is not so thick as on Wheeling creek.

A section of the Waynesburg coal in the river hill east of McMechen is given on page 285. There the upper bench has become very slaty, impure, and only 6 inches thick. The lower bench appears regular. On page 285 is found another section of the Waynesburg coal just south of the mouth of Grave creek at Moundsville. There the upper bench is only 2 inches thick and the lower bench has also begun to thin down. Due south of Moundsville and south from the latter along the Ohio river the bed becomes too thin to be of

any economic importance as shown by another section on page 286 at Powhatan station.

The writer measured the following section of this bed near the mouth of Crows hollow on Grave creek, one mile and a half northwest of Rosbys Rock station, just before the coal passes under the latter stream:

		Feet.	Inches
1.	Shale, dark	1	8
2.	Coal, slaty, (upper bench) 0′ 1″		
3.	Gray shale 0 6	1	1
4	Coal, slaty, (lower bench) 0 6		
5.	Fire clay to bed of run	0	6

It is readily seen that this coal bed dwindles rapidly in importance south from Moundsville, and in Tyler county and western Wetzel it is seldom recognized either from exposure where its horizon outcrops along the Ohio river front, or in the logs of the numerous wells bored for oil and gas.

Quantity of Available Waynesburg Coal.

It is much more difficult to approximate the available Waynesburg coal in the Marshall-Wetzel-Tyler area than it was of the Washington bed, since the latter is much more persistent than the former, and since the Waynesburg bed lies deeply buried over most of the area, it becomes hard to determine where it is safe to consider it a workable bed. Tyler county need not be considered in forming an estimate, but Marshall and Wetzel counties undoubtedly will furnish a large area of this coal of workable thickness.

The following table showing the depth to and thickness of the Waynesburg coal in several oil and gas wells, grouped by districts, is of special interest, in that it gives the average recorded thickness of this bed as slightly over four feet:

Table Showing Depth and Thickness of Waynesburg Coal.

No. on Map.	Name of Well.	District.	County	Depth Feet	Thickness Feet.
21	Upton Dorsey No. 1.....	Webster...	Marshall .	198	5
22	S. Lightner No. 1.....	Webster ..	Marshall..	290	2
24	J. T Cox No. 1.....	Webster...	Marshall .	290	6
4	Ed Francis No. 1.....	Washington	Marshall .	22	4
37	B. F. Phillips No. 1.....	Aleppo ...	Greene, Pa.	430	...
61	Ed Dorsey No 1.....	Liberty ...	Marshall..	400	...
66	Brice Howard Heirs No. 1	Liberty ...	Marshall..	609	...
69	Wm. Gray No. 1.....	Liberty ...	Marshall..	800	3
73	Lewis Chambers No. 2....	Liberty ...	Marshall..	765	3
76	H. E. Gray No. 1.....	Liberty ...	Marshall..	735	5
81	J. F. Dobbs No 1.....	Liberty ...	Marshall..	400	10
119	J. L. Hoffman No. 1.....	Liberty ...	Marshall..	305	3
39	Mary V. Wilson No. 1..	Meade	Marshall..	650	6
43	Gorby Heirs No. 1.....	Meade ...	Marshall..	724	5
47	Jennie Minor No. 1.....	Meade ...	Marshall..	210	3
48	John W West No. 1.....	Meade ...	Marshall..	380	5
78	Alley-Lewis No. 4.....	Meade ...	Marshall..	177	5
79	Nathan Shepard No. 1.....	Meade ...	Marshall..	162	8
95	Anderson core test.....	Meade ...	Marshall..	79	2
103	John Higgins No. 4.....	Clay	Marshall..	259	2
1	Sarah Anderson No. 1.....	Church....	Wetzel ...	480	5
2	Winona Shough No. 1.....	Church....	Wetzel ...	545	5
3	Jackson Hostutler No. 1...	Church....	Wetzel ...	972	2
14	W. H. Himmelrick No. 1..	Church....	Wetzel ...	420	2
22	G F. Throckmorton No. 1.	Church....	Wetzel ...	392	3
43	Wm. Devine No. 1.....	Church....	Wetzel ...	720	4
70	Ira Joliffe No. 1.....	Center ...	Wetzel....	704	2
104	T. J. Showalter No. 1.....	Center ...	Wetzel....	835	5
107	J. A. Lemasters No. 1.....	Center ...	Wetzel....	791	4
295	Jacob Yoho No 1.....	Proctor ...	Wetzel....	520	4
128	J. N. Camden core test..	Grant	Wetzel....	84	0.5
148	Annie Muffney No. 1.....	Grant	Wetzel....	325	...
150	Shuman core test.....	Grant	Wetzel....	248	1
177	M. V. Anderson core test..	Grant	Wetzel....	164	0.8
300	Ed Wagner core test....	Magnolia .	Wetzel....	no coal	0

For tidal elevation of wells, see tabular list of abbreviated well records for each county, pages 364, 404, and 476.

The approximate area of workable Waynesburg coal in Marshall county may probably cover most of the county, except Franklin district, and in Wetzel county the eastern portion of Proctor district, and all of Church, Clay and Center districts. Since a considerable portion of the original area of the coal has been eroded away in northern Marshall, the writer is of the opinion that it is safe to assume from the

data heretofore given an average thickness of two feet for this bed spread out over the entire workable area as above outlined, in estimating the total available Waynesburg coal in the area under discussion. Figuring on this basis we get the following results:

Available Waynesburg Coal in the Marshall-Wetzel-Tyler Area.

County.	Sq. Miles.	Acres.	Cubic Feet of Coal.	Short Tons of Coal.
Marshall	265	169,600	14,775,552,000	591,022,080
Wetzel	120	76,800	6,690,816,000	267,632,640
Totals	385	246,400	21,466,368,000	858,654,720

The above tonnage is obtained on the assumption that one cubic foot of Waynesburg coal weighs 80 pounds or the same as Washington coal, (see explanations following table of available Washington coal page 552).

The Uniontown Coal.

The next coal of economic importance in the Monongahela series below the Waynesburg bed is the Uniontown seam. A full description of the structure, stratigraphy, and general distribution of this bed over the Marshall-Wetzel-Tyler area is found on pages 289-294. A fine section of this coal is shown on page 290, taken from the log of the Edward Wagner core test well (W 300), located on the head of Coal fork of Doolin run, 2½ miles northeast of New Martinsville. The analysis of the coal from this test well is also found on the same page as well as in the table of coal analyses following page 577. Its fuel ratio (6.05), shown in the table of analyses referred to, gives this bed a higher relative rank than any other coal in the three counties, and in calorific value it is 200 to 300 British thermal units higher than the Pittsburg bed where mined within the area under discussion along the Ohio river.

Quantity of Uniontown Coal Available.

It is very difficult even to approximate the available tonnage of Uniontown coal in the Marshall-Wetzel-Tyler area. With the exception of a few core test well records, the only sources of information as to its persistence and thickness are the incomplete records of wells bored for oil and gas over the area. Although other coals may be encountered, many drillers as a rule record only the Sewickley and Pittsburg beds on account of their importance as "key rocks" in determining the position of oil and gas bearing sands.

In Marshall county this coal does not appear to have sufficient thickness to be of any economic importance, according to the logs of core test wells along the Ohio river front as well as the detailed logs of several oil and gas wells scattered over its area.

In the western half of Wetzel, this bed seems to thicken up as is well evidenced by the records of both the Ed Wagner wells on Coal fork of Doolin run, published on pages 271-274.

From the data given on pages 289-294 it is evident that there occurs a large area of probable commercial coal in western Wetzel and Tyler counties. The following table gives its depth and thickness as reported by the drillers in their logs of several oil and gas wells scattered over the area:

Table Showing Depth and Thickness of Uniontown Coal.

No. on Map.	Name of Well.	District.	County.	Depth. Feet.	Thickness. Feet.
22	S. Lightner No. 1.....	Webster ..	Marshall..	348	2
47	Jennie Minor No. 1.....	Meade ...	Marshall..	320	2
51	Hugh Cosgray No 1.....	Church....	Wetzel ...	880	4
128	J. M. Camden core test...	Grant	Wetzel....	180	1.5
150	Shuman core test.....	Grant	Wetzel....	350	2
177	M. V. Anderson core test..	Grant	Wetzel....	270	2.5
263	Abrigg No. 1.....	Green	Wetzel....	465	4
299	Ed Wagner No. 1.....	Magnolia .	Wetzel....	419	9

No. on Map	Name of Well.	District.	County.	Depth feet.	Thickness feet.
300	Ed Wagner core test	Magnolia .	Wetzel....	425	4.8
302	Samuel Martin No. 1.....	Magnolia .	Wetzel....	180	...
14A	J. T. Leasure No. 3.....	Lincoln ..	Tyler	355	5
18A	J B. McCoy No. 15.....	Lincoln ..	Tyler	100	3
62	John Lady No. 2.....	Union	Tyler	175	2
95	J. G. King No. 5.....	Ellsworth .	Tyler	315	2
96	J. G. King No 1.....	Ellsworth .	Tyler	470	1
97	J. G. King No. 2.....	Ellsworth .	Tyler	317	2
102	W. W. Allen No 1.....	Ellsworth .	Tyler	375	3
103	K. S. Boreman No. 2.....	Ellsworth .	Tyler	260	5
110	Pierpont Estate No. 1.....	Ellsworth .	Tyler	306	4
198	John Mercer No. 1.....	Centerville	Tyler	142	...
217	John Loneburger No. 5...	Meade ...	Tyler	198	2
220	Carse Heirs No. 6.....	Meade ...	Tyler	349	6
226	J W. Ankrom No. 6.....	Meade ...	Tyler	370	2
231	O. W. O. Hardman No. 2..	Meade ...	Tyler	465	2
236	H. D. Owens No. 3.....	Meade ...	Tyler	365	2
240	A. Broadwater No. 48.....	Meade ...	Tyler	225	2
243	A Broadwater No. 47.....	Meade ...	Tyler	240	3
244	J. S. Riggs No. 2.....	Meade ...	Tyler	230	2

For tidal elevation of wells, see tabular lists of abbreviated well records of each county, pages 364, 404, and 476. Under column headed "Depth", figures mean distances from top of hole, and not depth below drainage.

The average recorded thickness of the Uniontown coal in the wells in the above table is slightly over three feet. This bed does not carry the big slate parting like the Waynesburg bed and lying deeply buried over most of its probable workable area very little erosion of its original area has taken place. Hence, from all the data heretofore given the writer is of the opinion that the assumption of an average thickness of two feet of available commercial Uniontown coal spread over the entire workable area would be conservative in forming an approximate estimate of its available tonnage. This workable area appears to be confined to Magnolia district, the western portion of Proctor district, and the extreme western portion of Green district, all of Wetzel county, and Lincoln, Union, Ellsworth, and Meade districts of Tyler county. Figuring on this basis we obtain the following results.

Table Showing Available Uniontown Coal in the Area.

County.	Sq. Miles.	Acres.	Cubic Feet of Coal.	Short Tons of Coal.
Wetzel	70	44,800	3,902,976,000	156,119,040
Tyler	165	105,600	9,199,872,000	367,994,880
Totals	235	150,400	13,102,848,000	524,113,920

The above tonnage is obtained on the assumption that 1 cubic foot of Uniontown coal weighs 80 pounds, or the same as for the Washington and Waynesburg beds. (See explanation following table of available Washington coal, page 552.)

The Sewickley Coal.

The next coal seam of economic importance in the Marshall-Wetzel-Tyler area in descending order below the Uniontown coal is the Sewickley bed, a full description of which is found on pages 302-308 inclusive.

This coal is not mined on a commercial scale within the borders of the three counties, but where it outcrops along the Ohio river front of Marshall from Benwood to the mouth of Little Grave creek and at the mouth of Hog run, ½ mile northeast of Powhatan station, it has been mined considerably by farmers for local domestic fuel. At all other points of the area under discussion, its horizon lies deeply buried below drainage, coming 75 to 100 feet over the great Pittsburg bed. Hence, its depth below surface at any point can readily be approximately ascertained by the aid of the structure contours of the Pittsburg coal bed on the economic geology map accompanying this report.

In northern Marshall county this coal appears to be split into two distinct beds, separated by 18 to 20 feet of limy shale, the upper of which has been designated the **Upper Sewickley coal** and the other the **Lower Sewickley**. On page 304 is given a section of the Upper Sewickley coal as measured by the writer at the Catherine Smith opening on Boggs run, ⅓rd mile due east of the B. & O. R. R. bridge over the Ohio river at Benwood. The writer collected a

sample of this coal for analysis, the composition of which as reported by Prof. Hite is found at the top of page 305.

On the same page is found a section of the Lower Sewickley coal from its outcrop on the river hill at Benwood, and its composition as reported by Prof. Hite.

The Sewickley coal is at present being mined for local domestic fuel on the Hammond farm at the mouth of Hog run, ½ mile northeast of Powhatan station. Its section there and chemical analysis are both found on page 307.

The fuel ratio (2.78, 3.62 and 3.15 respectively) of these three samples of Sewickley coal gives this bed a higher rank than the Washington and Waynesburg beds, and in economic importance, it undoubtedly comes next to the Pittsburg coal below.

Quantity of Available Sewickley Coal.

The following table will give a fair idea of its thickness as recorded by the well drillers of a large number of borings for oil and gas scattered over its area in Marshall and Wetzel counties. As mentioned heretofore the Sewickley coal seems to disappear southward and is apparently of no economic importance in Tyler county:

Table of Wells Showing Depth to and Thickness of Sewickley Coal in the Marshall-Wetzel-Tyler Area.

No on Map.	Name of Well.	District.	County.	Depth Feet.	Thickness Feet.
21	Upton Dorsey No. 1	Webster	Marshall	405	4
22	S. Lightner No. 1	Webster	Marshall	486	3
24	J. T. Cox No. 1	Webster	Marshall	485	5
4	Ed Francis No. 1	Washington	Marshall	440	4
5	John Otte No. 2	Washington	Marshall	196	4
61	Ed Dorsey No. 1	Liberty	Marshall	580	...
65	Gartland Heirs No. 1	Liberty	Marshall	670	...
67	C. C. Lough No. 3	Liberty	Marshall	795	5
69	Wm. Gray No. 5	Liberty	Marshall	1010	4
70	John Bruhn No. 7	Liberty	Marshall	1020	3
71	V. P. Gorby No. 1	Liberty	Marshall	930	4
72	G. Richter No. 2	Liberty	Marshall	980	4
73	Lewis Chambers No. 2	Liberty	Marshall	950	3

No. on Map.	Name of Well.	District.	County.	Depth. Feet.	Thickness. Feet.
74	P. M. Conner No. 2	Liberty	Marshall	1005	3
75	F. E. Wayt No. 1	Liberty	Marshall	920	3
76	H. E. Gray No. 1	Liberty	Marshall	930	4
81	J. F. Dobbs No.1	Liberty	Marshall	580	5
82	John Bruhn No. 2	Liberty	Marshall	1000	2
119	J. L. Hoffman No. 1	Liberty	Marshall	500	4
126	W. V. Hoge No. 1	Liberty	Marshall	520	5
39	Mary V. Wilson No. 1	Meade	Marshall	804	8
43	Gorby Heirs No. 1	Meade	Marshall	955	6
47	Jennie Minor No. 1	Meade	Marshall	458	5
48	John W. West No. 1	Meade	Marshall	380	5
51	Isaac Crow No. 1	Meade	Marshall	280	5
52	John Young No. 1	Meade	Marshall	415	5
77	Geo. W. Bowers No. 1	Meade	Marshall	412	2
78	Alley-Lewis No. 4	Meade	Marshall	385	2
79	Nathan Sheppard No. 1	Meade	Marshall	370	3
85	A. J. Fronaphel No. 2	Meade	Marshall	940	5
88	Gertrude Stein No. 1	Meade	Marshall	1040	5
90	Joseph Nolte No. 6	Meade	Marshall	1075	...
92	Fred Wayman No. 2	Meade	Marshall	874	5
95	Anderson core test	Meade	Marshall	207	3.7
96	Ellen Fleming No. 1	Meade	Marshall	445	...
97	W. S. Howard No. 1	Franklin	Marshall	60	3
105	Hammond core test	Franklin	Marshall	5	4
112	Abersold core test	Franklin	Marshall	224	2.3
117	Jas. Henry No. 1	Franklin	Marshall	677	5
103	John Higgins No. 4	Clay	Marshall	440	6
104	Widow Beall No. 2	Clay	Marshall	70	6
34	S T. Alley No. 2	Richhill	Greene, Pa.	170	3
37	B. F. Phillips No. 1	Aleppo	Greene, Pa.	600	0
1	Sarah Anderson No. 1	Church	Wetzel	732	8
2	Winona Shough No. 1	Church	Wetzel	787	5
3	Jackson Hostutler No. 1	Church	Wetzel	1218	4
5	Barney Sines No 1	Church	Wetzel	1150	...
10	Wm. Renner No. 1	Church	Wetzel	800	5
10A	David Hostutler No. 1	Church	Wetzel	660	4
14	W. H. Himelrick No. 1	Church	Wetzel	685	5
15	Henry Hixenbaugh No. 1	Church	Wetzel	671	4
16	S. J. Elliot No. 1	Church	Wetzel	630	5
22	G. F. Throckmorton No. 1	Church	Wetzel	626	...
30	Sol. Shriver No. 1	Church	Wetzel	912	5
34	W. L. Cunningham No 1	Church	Wetzel	781	6
40	Mary E. Hunt No. 1	Church	Wetzel	576	0
41	R. H. Haines No. 1	Church	Wetzel	755	3
43	Wm. Devine No 1	Church	Wetzel	957	5
44	Geo. W. Thomas No. 1	Church	Wetzel	735	...
51	Hugh Cosgray No. 1	Church	Wetzel	1034	6
53	J. A. Conley No 1	Clay	Wetzel	770	4
56	G N. Gillingham No. 1	Clay	Wetzel	1090	...
64	S. Newman No. 3	Clay	Wetzel	794	...
65	Wm. Newman No. 3	Clay	Wetzel	832	...

No on Map.	Name of Well.	District.	County.	Depth. Feet.	Thickness. Feet.
67	Eliz. Anderson No. 1.....	Clay.....	Wetzel ...	712	...
68	Frank Wade No. 1.....	Center ...	Wetzel ...	735	3
70	Ira Joliffe No. 1.....	Center ...	Wetzel ...	935	4
74	Marion Gorby No. 1.....	Center ...	Wetzel ...	1025	5
85	W. J. Cross No. 1.....	Center ...	Wetzel ...	892	5
128	J. N. Camden core test....	Grant.....	Wetzel ...	326	2.2
142	F. B. Blake No. 1.....	Grant.....	Wetzel ...	1060	...
148	Annie Muffney No. 1.....	Grant.....	Wetzel ...	565	...
150	Shuman core test	Grant.....	Wetzel ...	505	1.5
177	M. V Anderson core test..	Grant.....	Wetzel ...	409	1.8
185	John Mills No. 88.....	Grant.....	Wetzel ...	552	...
257	J. R. Woods No. 2.....	Green.....	Wetzel ...	850	3
263	Abrigg No. 1.....	Green.....	Wetzel ...	635	5
290	H. R Thompson No. 1....	Proctor ...	Wetzel ...	1060	7
295	Jacob Yoho No. 1.....	Proctor ...	Wetzel ...	720	5
299	Ed Wagner No. 1.....	Magnolia..	Wetzel ...	no coal	0
302	Samuel Martin No. 1.....	Magnolia..	Wetzel ...	335	...

The tidal elevations of the wells are found in the tabular list of abbreviated well records on pages 364, 404, and 476.

From the above table and other data heretofore given, it is evident that the Sewickley coal as a workable bed extends practically over the entire area of all the districts of Marshall county, and over Church, Clay, and Center districts, Wetzel county, all of Proctor except a strip 2 to 3 miles wide on the southwest end, and probably 10 to 15 square miles on the northern end of Grant district, the same county. The average recorded thickness of the Sewickley coal in 56 wells selected from the above table and scattered over the above workable area as outlined, is 4.5 feet. With the exception of a narrow strip along the Ohio river front, this coal lies deeply buried and very little of its original area has been eroded. Hence, in forming an approximate estimate of the available tonnage, the assumption of an average thickness of three feet spread out over the entire workable area as outlined above, does not appear excessive. Figuring on this basis we obtain the following results:

Table Showing Available Sewickley Coal in Marshall and Wetzel Counties.

County.	Sq. Miles.	Acres.	Cubic Feet of Coal.	Short Tons of Coal.
Marshall	315	201,600	26,345,088,000	1,053,803,520
Wetzel	150	96,000	12,545,280,000	501,811,200
Totals	465	297,600	38,890,368,000	1,555,614,720

The Pittsburg Coal.

The next coal of economic importance in the Marshall-Wetzel-Tyler area below the Sewickley seam is the great Pittsburg bed, the geology and structure of which is fully described on pages 313-318 inclusive. In Tyler county this coal does not appear to be present in commercial thickness and purity (see page 315), but it is this bed that represents the greatest coal wealth of Marshall and Wetzel counties, and it is the only vein that is at present mined on a commercial scale in the Marshall-Wetzel-Tyler area.

It outcrops at only one point in the three counties; viz., along the Ohio river front of Marshall, extending from the Ohio-Marshall county line south to McMechen, where it passes below the river, not to reappear again within the area. Its outcrop line is shown on the economic geology map, accompanying this report.

As mentioned on a preceding page, the only commercial coal mines within the three counties are in the Pittsburg bed and these, seven in number, are confined to the Ohio river front of Marshall county, extending from Benwood to the mouth of Grave creek at Moundsville. The character and composition of the Pittsburg coal in these mines will now be taken up from north to south.

The Boggs Run Mining and Manufacturing Company has a mine in the Pittsburg coal, located on the Ohio river front at the north end of Upper Benwood, ⅓ mile north of the mouth of Boggs run near the Marshall-Ohio county line. The writer collected a sample for analysis and measured the following section in this mine:

		Feet.	Inches.
1.	Coal, "roof" thickness not exposed.....		
2.	Draw slate, gray.....	1	0
3.	Coal	2	1
4.	Slate, black.....	0	0½
5.	Coal	0	3
6.	Slate, black.....	0	0½
7.	Coal	1	5
8.	Sulphur band, "wedge bench".....	0	0¼
9.	Coal	1	2
10.	Coal	0	2
	Total	6	2¼

Elevation of mine opening (aneroid) 675 feet A. T.; butts run N. 75° W.; faces, S. 15° W.; greatest rise northwest; mine capacity, 200 tons in 8 hours; men employed, 40; coal used largely for steam purposes, and shipped to local plants at Benwood and Wheeling; sample for analysis taken from Nos. 3, 5, 7, 8 and 9 of the section, the composition of which as reported by Prof Hite is found under Laboratory No. 386-H in the table of analyses following page 577. No. 1 or the "roof" coal is left up in this mine as in all others in the Benwood and Moundsville regions. This "roof" coal ranges from 12″ to 24″ thick and when it is taken down, permitting the air to get at the overlying 6 to 8 feet of gray, limy shale extending up to the Redstone limestone, the roof caves in, since these limy shales readily disintegrate and often do not stop caving until the limestone above is reached. Hence, the "roof" coal may be considered an entire loss at the present time in all the Marshall county mines, since only the five feet of coal below the draw slate is taken. Even with the "roof" coal left up, more or less air permeates the same, causing bad falls along the entries and a continual expense to keep the haulage ways cleaned up.

The "draw slate" or No. 2 of section, coming immediately below the "roof" coal has to be removed at once, for it is quite treacherous and unsafe to be left unsupported. The air also affects it, causing it to crumble and become friable. Its thickness varies from 6 inches to as much as 3 feet.

The Wheeling Steel & Iron Company has a mine in the Pittsburg coal bed located in Benwood just north of the

eastern end of the B. & O. R. R. bridge over the Ohio river. The writer collected a sample for analysis and measured the following section in this mine:

				Feet.	Inches
1.	**Coal, "roof"**, thickness not exposed.				
2.	Draw slate, gray			0	10
3.	**Coal**	2′	2 ″		
4.	Slate, black	0	0½		
5.	**Coal**	0	3		
6.	Slate	0	0⅛	5	3⅞
7.	**Coal**	1	5		
8.	Sulphur band, "wedge bench"	0	0¼		
9.	**Coal**	1	5		
10.	Slate				

Tidal elevation, 640 feet A. T.; principal office at Wheeling, W. Va.; capacity, 300 to 500 tons for 8 hour day; number of men employed, 75; all coal mined is used at the Company's steel plant; butts run N. 75½° W ; faces, S. 14½° W.; greatest rise northwest; sampled for analysis (3), (5), (6), (7), (8) and (9) of the section, the composition of which as reported by Prof. Hite is found in the table of analyses following page 577 under Laboratory No. 387 H.

The Company manufactures about 100 tons a day of its output into producer gas for use in reheating steel before being rolled into tubing, very little if any sulphur being absorbed from the sulphur gas into the product. Mr. C. Dawson, Superintendent, and authority for mine data says the "Long-wall" system of mining does not work here on account of the roof not giving. The limestone above is not springy but breaks all at once. In the **pillar** and **room** system, one-third of the mining section is left in as **pillars** to support the roof and the coal not recovered. According to Mr. Dawson, attempts have been made to reduce the size of pillars left in, especially on the Ohio side of the river, and the result has been a squeeze causing a greater loss of coal. As a rule the various companies along the Ohio river in this county recover from 5000 to 6000 tons per acre, or about 60 per cent. of the working section of 5 feet of coal. If you count the "roof" coal, and the 4 to 5 inches of coal left in the bottom in rooms, then only about 45 per cent. of the total coal is recovered in the Benwood region.

In the Fairmont, W. Va., region the Fairmont Coal Co. claims to recover 90 per cent. of the total coal from their

mines in the Pittsburg bed. Much better roof conditions, however, prevail there.

The Mason Coal Works have a small mine in the Pittsburg coal bed at the mouth of Boggs run on the south side of the stream. This mine supplies a small local domestic trade and employs only two men. Only 3 to 4 acres of coal in their property is left unmined. No sample was taken here.

The Hitchman Coal & Coke Company have a mine in the Pittsburg coal bed located at the extreme southern end of Benwood on the Ohio river front. The writer collected samples for analysis and measured the following section in this mine in Room No. 26, in 6th West Butt of 6th North Face entry:

		Feet.	Inches
1.	**Coal, "roof"** (thickness not exposed).		
2.	Draw slate, gray, 7½ to	1	0
3.	**Coal** 1′ 10½″		
4.	Slate, black 0 0¼		
5.	**Coal** 0 4		
6.	Slate, black 0 0½		
7.	**Coal** 1 6½	5	3¾
8.	Sulphur band, "wedge bench" 0 0⅛		
9.	**Coal** 0 10⅞		
10.	**Coal** with sulphur band 0 7		
11.	Slate, hard and gray		

Tidal elevation of coal at mine entrance, about 600 feet; principal office of company, Wheeling, W. Va ; capacity, from 1500 to 2000 tons in 8 hours; number of men employed, 300 to 350; butts run S. 75° E.; faces, N. 15° E.; greatest rise, northwest; sample for analysis collected from Nos. 3, 5, 7, 8 and 9 of section, the composition of which is found under Laboratory No 375—H in the table of coal analyses following page 577; E. C. Pickett, Supt., and authority for mine data.

The coal from this mine as well as from other Marshall county mines in the Pittsburg bed, is highly prized for steam purposes. This plant is much the largest in the county, and a large percentage of its output is used in coaling the engines of the several divisions of the B. & O. R. R., terminating near here. This coal is preferred by the railroad firemen over that of the same bed in the Fairmont region.

This company has bad roof conditions to contend with and the "roof" coal is left up to help support the overlying

strata, or rather to prevent the moisture of the atmosphere getting to the easily caving shales overlying the roof coal.

In the Benwood region 4 to 6 inches of coal is often left in bottom of rooms on account of excess of sulphur. The writer collected a sample for analysis of this **bottom coal** in the Hitchman mine, the composition of which as reported by Prof. Hite is found under Laboratory No. 378½-H in the table of coal analyses following page 577.

A sample of the "roof coal" was also collected by the writer in this mine about 2000 feet in from the entrance on No. 3 Main Heading. The following section was measured at this point:

				Feet.	Inches
1.	Shales, gray and limy.				
2.	Slate, black, with streaks of coal....	2′	6″	"Roof" .. 4	2
3.	**Coal**	1	6		
4.	Coal, slaty.....	0	2		
5.	Draw slate, gray.....			0	10
6.	Coal	2′	0 ″		
7.	Slate, black.....	0	0½		
8.	Coal	0	4		
9.	Slate, black.....	0	0⅛		
10.	Coal	1	6	5	3½
11.	Sulphur band, "wedge bench"	0	0⅛		
12.	Coal	1	3		
13.	Sulphur band, "fire parting".	0	0¼		
14.	Coal	0	1½		
15.	Limestone, hard.....				

Took sample for analysis of No. 3 only of roof coal, the composition of which as reported by Prof. Hite is found under Laboratory No. 379—H in the table of coal analyses following page 577. It is easily observed that this "roof coal" is not so pure as the main bed, carrying a much higher percentage of ash and running about 2000 B. T. U lower in calorific value. Its fuel ratio (2.29) places it in rank along with some of the best coals of the Dunkard series.

In the Ohio valley region, **clay seams** frequently occur in the Pittsburg bed in an almost vertical position. In the Hitchman mine five seams have already been encountered. Numbering from the river eastward we find the following:

No. 1 clay seam bears S. 30° E.
No. 2 clay seam bears S. 24¼° E.
No. 3 clay seam bears S. 13° E.
No. 4 clay seam bears S. 9½° E.
No 5 clay seam bears S. 16½° E.

Measured nearly along the main heading we find the following intervals separating these seams: No. 1 to No. 2. is 860 feet; No. 2 to No. 3 is 710 feet; No. 3 to No. 4 is 825 feet; and No. 4 to No. 5 is 1300 feet. They all seem to be rudely parallel. The direction of their intrusion does not appear to have any relation to the butts and faces of the coal, but possibly is nearly at right angles to the line of strike. The clay seams are wedge shaped with the thin edge (averaging about two feet thick) down. Sometimes not all the coal is cut out.

The Glendale Coal Company has a shaft mine to the Pittsburg coal bed, located at the north end of Glendale, 3 miles due north of Moundsville. This mine is operated by the above company, the stock of which is owned by the Hitchman Coal & Coke Co. The shaft to this mine is 96 feet in depth to the base of the coal. The writer collected a sample for analysis and measured the following section in this mine in Room No. 13, off No. 4 West, off 1st North Face-entry:

		Feet.	Inches
1.	**Coal, "roof"** 12″ to	2	0
2.	Slate, gray 12″ to	0	8
3.	**Coal** 2′ 3″		
4.	Slate, black ¼″ to 0 1		
5.	**Coal** 0 4		
6.	Slate, black 0 0¼	5	6
7.	**Coal** 2 8		
8.	Sulphur band, "fire parting" 0 0¼		
9.	**Coal** 0 1½		
10.	Limestone		

Tidal elevation, 590 to 595 feet; capacity, from 350 to 500 tons for 8 hour day; number of men employed, 100; ship coal both by river and rail; used both for steam and domestic purposes; butts run S. 71½° E; faces, N. 18½° E.; greatest rise, northwest; authority for mine data; E. C. Pickett.

The direction of a clay seam in this mine is S. 36° E., or nearly at right angles to the strike of the rocks. A sample for analysis was selected from Nos. 3, 5, 6 and 7 of the section, the composition of which is found under Laboratory No. 380-H in the table of coal analyses following page 577.

The Mound Coal Company has a shaft mine in the Pittsburg coal, located on the south side of Parr run of Little

Grave creek in the city of Moundsville. The shaft to the base of the coal is about 160 feet in depth. The writer collected a sample for analysis and measured the following section in this mine:

		Feet.	Inches
1.	**Coal, roof 12" to**	1	6
2.	Draw slate, gray	0	9
3.	**Coal** 2′ 0 ″		
4.	Band, black slate 0 0⅛		
5.	**Coal** 0 5½		
6	Band, black slate 0 0⅛	5	2¼
7.	**Coal** 1 7		
8.	Sulphur band, wedge 0 0½		
9.	**Coal** 1 1		
10.	Slate		

Tidal elevation of coal at bottom of shaft, about 500 feet; principal office of company, Wheeling, W. Va.; capacity of mine, 250 tons in 8 hours; number of men employed, 35; sampled for analysis Nos. 3, 4, 5, 6, 7, and 9 of section, the composition of which as reported by Prof. Hite is found under Laboratory No. 383—H in the table of coal analyses following page 577; Peter Lowther, Supt. and authority for mine data. The output from this mine is used for steam purposes by local plants and for local domestic fuel.

The Bituminous Coal Company of America has recently sunk a shaft to the Pittsburg coal on the head of Parr run, slightly over one mile northeast of the Mound Coal Co.'s shaft. The writer collected a sample here for analysis and measured the following section near the foot of the shaft in Room No. 1, off No. 1 Left Butt entry:

		Feet.	Inches
1.	**Coal "roof"**	1	10
2.	Draw slate, gray	0	10
3.	**Coal** 2′ 2 ″		
4.	Slate, black 0 0⅛		
5.	**Coal** 0 4¾	5	2
6.	Slate, black 0 0⅛		
7.	**Coal** 2 7		
8.	Slate		

Tidal elevation (spirit level measurement) bottom of coal, 504 feet; depth of shaft, 416 feet; principal office of company, Moundsville, W. Va.; capacity, just opening up; authority for mine data, O. K. Ward, Supt.; sampled for analysis Nos. 3-7, inclusive, of section, the composition of which as reported by Prof. Hite is found under Laboratory No. 381—H in the table of coal analyses following page 577.

The Washington coal, 18" to 20" thick, is flush with the

top of the shaft, giving the Washington-Pittsburg coal interval as 410 feet in this portion of Marshall county.

The Panama Coal Mining Company has a shaft mine in the Pittsburg coal located on the south bank of Grave creek, ¾ mile due south of the B. & O. R. R. station at Moundsville. This is farthest south of any of the mines in Marshall county and the depth of the shaft is 188 feet. The writer collected a sample for analysis and measured the following section in this mine in Room No. 1 on Main entry:

				Feet.	Inches.
1.	Coal, roof 6" to			1	6
2.	Draw slate, gray 2" to			1	5
3.	Coal	1′	11 "		
4.	Slate, black	0	0¼		
5.	Coal	0	7		
6.	Slate, black	0	0⅛	5	2⅞
7.	Coal	1	7		
8.	Sulphur band	0	0½		
9.	Coal	0	10		
10	Coal, impure	0	3		
11.	Slate				

Tidal elevation of bottom of shaft, about 485 feet; principal office, Pittsburg, Pa.; number of men employed, 24; butts run N. 70° W.; faces, S. 20° W.; greatest rise, northwest; authority for data, W. G. Cronkright, Supt.; sampled Nos. 3-9 inclusive, the composition of which as reported by Prof. Hite is found under Laboratory No. 382-H in the table of coal analyses following page 577.

In excavating the shaft the **Sewickley coal** was penetrated and found to be 7 feet thick, but when worked for fuel to finish the shaft, it thinned down to 4 feet of clean coal, the thickness generally recorded for this bed along the Ohio river in Marshall county.

A glance at the analyses of the coal from the foregoing Marshall county mines in the Pittsburg bed will readily show that the coal runs too high in sulphur for the manufacture of coke or illuminating gas. However, it has a great reputation as a steam producer and also for domestic purposes.

On the opposite side of the river in the Bellaire region of Ohio the Pittsburg coal has the same structure as on the W. Va. side as is shown by the section of the Pultney mine published on page 318. The writer collected a sample below

the draw slate for analysis, the composition of which is found under Laboratory No. 384-H in the table of coal analyses following page 577. The roof coal is left up for the same reason as on the W. Va. side, and the same draw slate occurs below the "roof coal."

Through the courtesy of W. C. Myer of Morgantown, W. Va., the Survey is enabled to obtain the analysis of the Pittsburg coal from the Geo. Peters core test well (M 110), drilled by Alex. Dempster and located near the mouth of Sims run, ¾ths mile northeast of Clarington station. The analysis, according to Mr. Myer, was made by Mr. Jas. H. Knowlton, Chief Chemist for Elkins Coal & Coke Co., Morgantown, W. Va., and is as follows:

	Per cent.
Volatile Matter	40.52
Fixed Carbon	53.36
Ash	6.12
Total	100.00
Sulphur	2.77

The coal appears to run about the same in volatile matter as at Benwood and Moundsville, but 4 to 5 per cent. higher in fixed carbon, and 1.5 per cent. lower in sulphur.

Through the courtesy of Mr. C. McC. Lemley, Asst. Engineer, B. & O. R. R. Co., the Survey is enabled to obtain the analysis of the Pittsburg coal in another core test well on the W. W. Ewing farm (M 15), located on the north bank of Wheeling creek, ½ mile southwest of Viola P. O., the log of which is published on page 263. The analysis as reported by Mr. Lemley is as follows:

	Per cent.
Moisture	1.30
Volatile Matter	37.70
Fixed Carbon	50.55
Ash	10.45
Total	100.00
Sulphur	4.79

The sulphur appears about the same as in the Benwood region, but the ash is about 2 per cent. higher.

Several core test wells have been drilled through the

Pittsburg coal in Wetzel county by private interests, but the writer was unable to obtain for publication the analysis of coals encountered.

The Survey however obtained the analysis of a sample of Pittsburg coal in Wetzel county, taken from an oil well while penetrating the Pittsburg bed. This analysis was furnished by Chas. Heyer, Sec. and Treas. of the Cook Coal & Coke Company of Philadelphia, Pa., reported it as follows:

"On June 13th, 1907, Mr. H. L. Aikin, Chemist, 717 W. Seventh St., Chester, Pa., made an analysis of samples of Smithfield coal for us and he reported the following:

	Per cent.
Moisture	1.40
Volatile Matter	40.45
Fixed Carbon	52.65
Ash	5.50
Total	100.00
Sulphur	1.89
Phosphorus	0.0071

"The coal was sent us as having been taken from an oil well near Smithfield, W. Va. The coal was between 500 and 600 feet deep. The seam at that point drilled was about nine feet thick and appeared to be in perfect formation."

The Fairmont Coal Company put down a diamond drill boring north of Smithfield, and it is reported that the Pittsburg coal was found with a thickness of 7 feet, and a sulphur content of slightly more than 2.50 per cent. so that the coal represented in the above analysis is most probably from the "main bench" or purer portion of the Pittsburg bed.

Quantity of Pittsburg Coal Available.

It is easier to make an approximate estimate on the available tonnage of the Pittsburg coal bed than any other seam in the three counties, since it is always noted when present in the logs of the many oil and gas wells drilled over the area on account of its value to the drillers as a key

rock. On pages 314-315 is given a full description of the probable workable area and thickness of the Pittsburg coal in the three counties. The reader is referred to the tables of abbreviated well records of each county on pages 364, 404, and 476. There enough figures are given to warrant the assumption of an **average thickness of six feet** of this coal spread out over the entire workable area of the bed. On the economic geology map accompanying this report the writer has indicated the approximate western boundary line of workable Pittsburg coal in Wetzel county. An approximate determination of the area of that portion of Wetzel county has been made by districts to the east of this **boundary line,** as well as the area of Pittsburg coal left in Marshall county as follows:

	Sq. miles.
Marshall county	314.00
Wetzel County:	
Grant district....82.0 sq. mi.	
Proctor district....50.0 sq. mi.	
Church district....37.77 sq. mi.	
Clay district....17.05 sq. mi.	
Center district....44.60 sq. mi.	
Greene district....7.00 sq. mi.	
Magnolia district....0.00 sq. mi	238.42

Figuring on this basis we get the following results:

Table Showing Available Pittsburg Coal in the Area.

County.	Sq. Miles.	Acres.	Cubic Feet of Coal.	Short Tons of Coal.
Marshall	314	200,960	52,522,905,600	2,100,916,224
Wetzel	238	152,320	39,810,355,200	1,592,414,208
Totals	552	353,280	92,333,260,800	3,693,330,432

In obtaining the above results it is assumed by the writer that 1 cubic foot of Pittsburg coal weighs 80 pounds (see explanations following table of available Washington coal, page 552).

THE COALS OF THE ALLEGHENY SERIES.

The Lower Freeport Coal.

The only coal that appears to be of any economic importance in the Allegheny series in the Marshall-Wetzel-Tyler area is the Lower Freeport bed, a full description of which is found on pages 336-338. Its horizon has been noted in 3 or 4 oil well records within the boundaries of the four northern districts of Marshall county; viz., Union, Sand Hill, Washington and Webster. Southward from this region it appears to be absent. No core test wells to the writer's knowledge have yet penetrated the Allegheny series within the area, but the record of the following well a short distance north from the Marshall-Ohio county line, is of special interest since the record was kept in detail and all measurements made with a steel tape:

Steenrod No. 1 Well Record, Ohio County, W. Va.

Located near Wheeling, W. Va., 1.3 mile N. 80° E. of mouth of Wheeling creek. Drilled by Wheeling Producing Oil & Gas Co. Authority, S. H. Brockunier. Elevation above tide, 658 ft.; starts 60 ft. below Pittsburg coal.

		Thickness Feet.	Total Feet.
Gravel		60	60
Lime		45	105
Fire clay		15	120
Red shale		2	122
Slate		28	150
Fire clay		15	165
Lime		10	175
Red rock		10	185
White slate, limy and some shale		115	300
Shale		2	302
Red rock		20	322
Slate, white		118	440
Coal horizon (Upper Freeport)		0	440
Lime		86.5	526.5
Slate, white		6	532.5
Coal, Lower Freeport		5	537.5
Lime		27.5	565
Slate, black		72	637
II Cow Run sand, coarse (Homewood)		109	746
Coal, (few inches) (Mercer)		0	746
Sand	**Salt**	52	798
Sand, much mixed with black slate for 40'	**Salt**	87	885

	Thickness Feet.	Total Feet.
Black slate	6	891
Sand, white and hard (Maxton)	39	930
Big lime	56	986
Keener sand	39	1025
Break	5	1030
Big Injun sand, oil show 1065'	87	1117

This well shows a thickness of 5 feet for the Lower Freport coal. However, the writer hardly feels justified in making an estimate of possible coal tonnage from this bed on data so meagre as to the actual thickness and character of this coal in northern Marshall county. If it should prove to be present over the area as outlined in northern Marshall, say possessing an average thickness of 3 feet, then we would have to add 384,700,000 short tons to our available coal tonnage.

The following table is a summary of the available tonnage of all coals in the Marshall-Wetzel-Tyler area:

Summary of Available Coal in the Three Counties.

	Short tons.
Washington coal	2,087,200,050
Waynesburg coal	858,654,720
Uniontown coal	524,113,920
Sewickley coal	1,555,614,720
Pittsburg coal	3,693,330,432
Grand total	8,718,913,842

The above estimate of 8,718,913,842 tons of available coal left unmined in the Marshall-Wetzel-Tyler area does not necessarily mean that such an amount will eventually be taken out. The percentage of coal recovered under present mining methods of any mining section, not counting roof and bottom coals often left untouched, varies in West Virginia from 60 to 90 per cent. If the roof and bottom coals be taken into account in the mines of the Benwood and Moundsville regions, then only 45 per cent. of the total coal in the Pittsburg bed is recovered. The writer believes that a percentage of recovery of 60 per cent of the total coal present would be a conservative estimate. Figuring on this basis, then our available tonnage of 8,718,913,842 in the counties of Marshall, Wetzel and Tyler is reduced in round numbers to 5,231,000,000 short tons.

ANALYSES OF COALS IN MARSHALL, WETZEL AND TYLER COUNTIES.

(Under the heading "Condition of Sample." "A. R"= as received, "A. D." = air dried, and "C. F. M." = corrected for moisture.)

Series	Lab. No.	MINE	COUNTY	HORIZON	Condition of Sample	PROXIMATE.				COMMON TO BOTH		ULTIMATE				Calorimeter B. T. U. For 1 lb of Coal.	Calculated B. T. U. For 1 lb. of Coal	CARBON / Oxygen plus Ash
						Moisture	Volatile Matter	Fixed Carbon	Phosphorus	Ash	Sulphur	Carbon	Hydrogen	Oxygen	Nitrogen			
Dunkard	406-H	J. H. Six*	Wetzel	Nineveh	A. R.	15.11	22.50	32.63	0.01	29.73	1.47	35.75	5.05	27.34	0.66		6 276	0.62
	401-H	Moses Bartrug	"	Hostetter	A. R.	1.97	36.39	18.31	0 042	13.33	3.52	67.57	6.33	8.67	1.18		13.270	3 16
	353-H	Public Road*	"	Fish Creek	A. R.	0.80	39.90	13.05	0.098	16.25	3.20	70.91	4.30	4.42	0.92	13 018	12,767	3 78
	405-H	S. McFarland*	"	Dunkard	A. R.	1.53	32.08	12.71	0 24	23.68	7.24	55 90	6 20	6.10	0.88		11,735	1 88
	407-H	J. P. Hagan	Greene, Pa.	Jollytown	A. R.	1.12	29.38	43.70	0.11	25.80	3.14	55 28	5.58	9.19	1.01		10,939	1 58
	395-H	Wm. Bruce	Tyler	Jollytown ?	A. R.	1.60	31 72	18 26	0.1	16.02	6.39	65.58	6.17	4.88	0.66	12 309	13,131	3 13
	390-H	Turkey Run*	Wetzel	Washington	A. R.	1.01	34 37	45.76	0.007	18.83	2.76	65.39	5 66	6.42	0.91	11,885	12,636	2 58
	102-H A	Wagner Core Test.	"	Wash. (U bench)	A. R.	1.75	29.43	36.72	0.008	31.90	1.78							
	102-H A	Wagner Core Test.	"	Wash.(L. bench)	A. R.	1 68	36 05	47.87	0.003	14.40	6.35							
	391-H	E. Ressegger	"	Washington	A. R.	0 92	36 57	47 66	0.016	14.85	3.82	67.35	5 10	7 93	0.95	12,349	12,199	2 95
	392-H	Henry Buck	Tyler	"	A. R.	1.52	31 11	44.80	0.001	22.47	6 81	49.37	1.54	6.60	0.78	11,205	11,262	2 08
	396-H	M. A. Buck	"	"	A. R.	0.36	35 67	46.68	0 015	17 29	3.76	65 63	5 32	7.26	0 71	12 361	12,132	2 67
	397-H	James Eddy	"	"	A. R.	0.99	35 73	52 29	0 007	10.99	2 51	69.65	5.86	10.13	0.83	13,013	13,079	3 29
	102-H	W. J. Hall	Marshall	Waynesburg "A"	A. R.	1 01	35.25	16.03	0.036	17.71	2.88	62.67	5.74	10.15	0.85		12,001	2 25

* Not mined. Sample taken at outcrop.

ANALYSES OF COALS IN MARSHALL, WETZEL AND TYLER COUNTIES.—Continued.

(Under the heading "Condition of Sample," "A. R." = as received, "A. D." = air dried, and "C. F. M." = corrected for moisture.)

Series	Lab. No.	MINE	COUNTY	HORIZON	Condition of Sample.	PROXIMATE				COMMON TO BOTH		ULTIMATE					Calorimeter B. T. U. for 1 lb. of Coal.	Calculated B. T. U. for 1 lb. of Coal.	CARBON / Oxygen plus Ash
						Moisture	Volatile Matter	Fixed Carbon	Phosphorus	Ash	Sulphur	Carbon	Hydrogen	Oxygen	Nitrogen				
Monongahela	398-H	Jno. Sheppard	Marshall	Waynesburg	A. R.	0.71	37.58	46.64	0.008	15.07	4.25	65.45	5.50	8.76	0.97		12,433	12,427	2.74
	400-H	Vincent Gray	"	Wbg. (U. bench)	A. R.	0.19	33.22	46.49	0.055	20.10	3.08	61.34	6.32	8.05	1.11		11,361	12,345	2.17
	399-H	Vincent Gray	"	Wbg. (L. bench)	A. R.	0.83	35.18	48.71	0.025	15.28	3.89	64.78	5.43	9.61	1.01		12,207	12,203	2.60
	401-H	Wm. Dague	"	Waynesburg	A. R.	0.43	34.40	47.67	0.021	17.50	3.70	63.23	6.31	8.24	0.99		12,008	12,639	2.45
	101-H	Wagner Core Test.	Wetzel	Uniontown	A. R.	1.68	37.07	53.07	0.003	8.18	1.20	77.82	4.11	4.67	1.02		13,739	13,676	6.05
	388-H	C. Smith	Marshall	U. Sewickley	A. R.	1.18	33.93	50.77	0.006	14.12	2.77	67.07	4.89	9.99	1.16		12,537	12,131	2.78
	389-H	No Mine*	"	L. Sewickley	A. R.	1.37	38.00	49.04	0.013	11.59	3.95	69.79	5.46	7.67	1.54		12,995	13,101	3.62
	403-H	Hammond	"	Sewickley	A. R.	0.98	38.74	48.96	0.009	11.32	3.18	68.65	5.39	10.50	0.96			12,638	3.10
	386-H	Boggs Run	"	Pittsburg	A. D.	1.60	40.30	51.11	0.004	6.99	4.60	72.25	5.81	9.47	1.18			13,584	4.47
	386-H	Boggs Run	"	"	C.F. M.	1.98	40.15	50.91	0.004	6.96	4.58	71.97	5.83	9.48	1.18			13,537	4.45
	387-H	Benwood Mill	"	"	A D.	1.36	39.84	49.89	0.005	8.91	4.50	72.00	5.60	7.94	1.05			13,513	4.27
	387-H	Benwood Mill	"	"	C.F. M.	1.72	39.69	49.71	0.005	8.88	4.48	71.73	5.62	8.24	1.05			13,460	4.19
	375-H	Hosack	"	"	A. D.	1.75	40.90	49.58	0.014	7.77	4.17	71.73	5.67	9.63	1.03		13,515	13,374	4.12
	375-H	Hosack	"	"	C.F. M.	2.68	40.51	49.11	0.014	7.70	4.14	71.05	5.78	10.31	1.02		*13,388	13,286	3.91
	378½-H	Hosack	"	" (floor)	A. D.	1.73	38.77	53.41	0.005	6.09	5.06	72.46	6.07	9.18	1.14			13,795	4.74
	378½ H	Hosack	"	" (floor)	C.F. M.	2.13	38.61	53.20	0.005	6.06	5.04	72.16	6.09	9.51	1.14			13,738	4.63
	379-H	Hosack	"	" (roof)	A. D.	1.55	36.73	41.83	0.022	19.89	3.86	62.84	4.89	7.54	0.98		11,467	11,746	2.29
	379-H	Hosack	"	Pittsburg (roof)	C. F. M.	2.37	36.35	41.40	0.022	19.68	3.82	62.19	5.01	8.33	0.97		11,348	11,662	2.22
	380-H	Glendale	"	Pittsburg	A. D.	1.12	40.38	51.27	0.018	7.23	4.75	73.09	5.40	8.51	1.02		13,556	13,515	4.61
	380-H	Glendale	"	"	C. F. M.	2.86	39.93	50.00	0.018	7.15	4.67	71.79	5.59	9.80	1.00		13,318	13,335	4.23
	381-H	Bituminous No. 1.	"	"	A. D.	1.60	35.03	50.22	0.005	13.15	4.50	70.56	6.56	4.15	1.08			14,190	4.08
	381-H	Bituminous No. 1.	"	"	C. F. M.	2.03	34.88	50.00	0.005	13.09	4.48	70.25	6.58	4.52	1.08			14,132	3.98
	383-H	Mound	"	"	A. D.	1.55	38.35	53.17	0.004	6.93	3.75	73.86	5.75	8.67	1.01			13,790	4.73
	383-H	Mound	"	"	C. F. M.	1.80	38.25	53.01	0.004	6.91	3.74	73.68	5.77	8.86	1.01			13,758	4.67
	382-H	Panama	"	"	A. D.	1.56	35.53	54.13	0.004	8.78	3.76	73.78	6.46	6.44	1.08			14,201	4.81
	382 H	Panama	"	"	C.F. M.	1.86	35.42	53.97	0.004	8.75	3.75	73.56	6.17	6.69	1.08			14,156	4.76
	384-H	Pultney	Belmont, Ohio	"	A. R.	2.12	40.52	48.21	0.017	9.15	4.90	71.84	5.44	7.67	1.00		13,424	13,426	4.27
	385-H	Rail and River	Belmont, Ohio	"	A. R.	2.17	39.07	49.30	0.012	9.46	4.01								

* Sample taken at outcrop. Not mined.

Location of Samples in Table.

Analyses Nos.

406-H. Outcrop coal, land of J. H. Six, head of Cappo run of Church Fork, Church district, Wetzel county. See page 178.

404-H. Mine on land of Moses Bartrug one-fourth mile northeast of Burton, Wetzel county. See page 183.

353-H. Outcrop coal, public road, Sugar Run, one hundred yards east of Church-Clay-Center district corner, Wetzel county. See page 188.

405-H. Outcrop coal, land of S. A. McFarland, west end of Burton, Church district, Wetzel county. See page 192.

407-H. Mine on land of J. P. Hagan, Town run, one-fourth mile north of Jollytown, Gilmore township, Greene county, Pa. See page 197.

395-H. Mine on land of Wm. Bruce, Saltlick run, ¾ mile southwest of Pursley, Lincoln district, Tyler county. See page 205.

390-H. Outcrop coal, mouth of Turkey run of Fishing creek, 1 mile N. 70° W. of Porters Falls, Green district, Wetzel county.

102-HA. Core test, land of Ed Wagner, Coal Fork of Doolin run, 2⅓ miles northeast of New Martinsville, Magnolia district, Wetzel county. See page 271.

391-H. Mine on land of E. Resseger, Doolin run, 2 miles east of New Martinsville, Magnolia district, Wetzel county.

392-H. Mine on land of Henry Buck, Buck run of Pt. Pleasaut creek, 3½ miles N. 75° W. of Sistersville, Lincoln district, Tyler county

396-H. Mine on land of M. A. Buck Winze run of Sancho creek, 2.8 miles due south of Middlebourne, Ellsworth district, Tyler county.

397-H. Mine on land of James Eddy, Coallick run of Pt. Pleasant creek, 1 mile northeast of Kidwell, Ellsworth district, Tyler county.

402-H. Mine on land of W. J. Hall, Fish creek, one mile and a third N. 80° W. of Meighen, Meade district, Marshall county. See page 234.

398-H. Mine on land of John Sheppard, near mouth of Burches run of Wheeling creek, Union district, Marshall county. See page 285.

400-H. Mine on land of Vincent Gray, north side of Wheeling creek, one-fifth mile west of Viola, Sand Hill district, Marshall county.

399-H. Same location as 400-H. Lower bench of coal.

401-H. Mine on land of Wm. Dague, south side of Wheeling creek, opposite Viola, Webster district, Marshall county.

101-H. Wagner core test, same location as 102-HA.

388-H. Mine on land of Catherine Smith, Boggs run, one-third mile due east of B. & O R. R. bridge at Benwood, Union district, Marshall county. See page 304.

389-H. Outcrop coal, river hill, Benwood, Union district, Marshall county. See page 305.

Analyses Nos.

403-H. Mine on land of Hammond Heirs, mouth of Hog run, ½ mile northeast of Powhatan station, Clay district, Marshall county.

386-H. Boggs Run mine of the Boggs Run Mining & Manufacturing Co., one-third mile north of mouth of Boggs Run, Upper Benwood, Union district, Marshall County.

387-H. Benwood Mill mine of the Wheeling Steel and Iron Co. at east end of B & O. R. R. bridge, Benwood, Union district, Marshall county.

375-H. Hosack mine of the Hitchman Coal and Coke Co., McMechen run, extreme south end of B. & O. R. R. yards, Benwood, Union district, Marshall county.

378½-H. Same mine as 375-H.

379-H. Same mine as 375-H.

380-H. Glendale mine of the Glendale Coal Co., Ohio river front, north edge of Glendale, Washington district, Marshall county.

381-H. Bituminous mine No. 1 of the Bituminous Coal Co. of America, Parr run, one mile and a half northeast of Moundsville, Washington district, Marshall county.

383-H. Mound mine of the Mound Coal Co., Parr run, city of Moundsville, Washington district, Marshall county.

382-H. Panama mine of the Panama Coal Mining Co., Grave creek ¼ mile from mouth, Clay district, Marshall county.

384-H. Pultney mine of the Cambria Mining Co., Ohio river front, opposite McMechen, in Pultney township, Belmont County, Ohio.

385-H. Rail and River mine of the Rail and River Coal Co., Ohio river front, ¼ mile north of Florence, Pultney township, Belmont County, Ohio.

CHAPTER X.

CLAYS, ROAD MATERIALS, AND BUILDING STONE.

THE CLAY AND CLAY INDUSTRY IN MARSHALL, WETZEL, AND TYLER COUNTIES.

In Volume III of the State Survey reports is found a general review of the clay industry in West Virginia by Prof. G. P. Grimsley, with a discussion of the origin, physical and chemical properties of clays, their classification and uses.

In the area under discussion there are no outcropping deposits of fine fire clay, but it is probable that the northwestern portion of Marshall county is underlaid by the Kittanning fire clay, the stratum which forms the principal basis for the brick industry at New Cumberland, W. Va., and other Ohio valley towns of that region. The Glenova diamond drill boring, located north of Wheeling, 6½ miles north from the Marshall-Ohio county line, partial records of which are given on pages 328-329 and 322-323, reports this clay 20 feet thick and of excellent quality. Dr. I. C. White[1] has the following to say concerning the clay at this point:

"In the Glenova boring this fire clay has the unusual thickness of 20 feet, and is of most excellent quailty, so far as can be determined from physical structure and general appearance. The uppermost portion, seven feet in thickness,

1. Ohio-Brooke-Hancock Report, Introduction to. W. Va. Geol. Survey.

is light colored, while the rest of it is dark gray, both the "plastic" and "flint" varieties being represented in each color. When in the not distant future, shafts are sunk in the vicinity of Wheeling through which to mine the Lower Freeport coal, No. 58 of the boring, for either fuel or coke in order to supply the necessities of this great manufacturing center, it should prove a very profitable investment to continue these shafts down 120 odd feet lower into this great bed of clay which has yielded such rich returns to the industrial life of Hancock county and the neighboring towns of Toronto, East Liverpool and Wellsville just across the Ohio river."

Outcropping shales and old terrace deposits along the Ohio river and its larger tributaries in each of the three counties furnish ideal material for the manufacture of common building brick. These terrace clays are often quite sandy and are adapted only to the manufacture of the latter kind of brick. These deposits possess the advantage that no blasting is required to obtain material, the latter being ploughed up or removed by pick and shovel. There is one brick plant in each county and their description will now be taken up.

The following description of a brick plant in Moundsville, Marshall county is given by Prof G. P. Grimsley[2]:

Suburban Brick Company.—The office of this company is located in Wheeling, but the plant is located one mile and a half northeast of Moundsville and was started in 1891, and purchased by present company in 1900.

The equipment includes a nine-foot Stevenson dry pan, pug mill, Arnold-Creager brick machine with daily capacity of 25,000 brick. There are two tunnel driers, one with four tracks and the other with ten tracks, giving a combined capacity of 60 000 brick. The brick are burned in one 20-arch up-draft kiln, holding 325,000 brick, and three 17-arch up-draft kilns holding 275,000 brick each. Coal is used for fuel, and building brick only are made.

Shale Pit.—The shale is mined in open quarry from the

2. Vol. III., pages 255-256, W. Va. Geol. Survey.

hill above the plant and hauled down an incline track in mine cars. The pit shows the following strata:

	Feet.	Inches.
Cover, soil and sandstone boulders	0	30
Coal (Little Waynesburg)	0	10
Shale with irregular nodules of lime	10	0
Shale, buff, in thin layers	7	0
Sandstone	2	6
Shale, buff in thin layers	10	0
Black coal-like shale	0	2
Shale, breaks in blocks	15	0
Limestone floor	4	0
Blue shales	2+	

Less than a mile west the Pittsburg coal is mined in a shaft 160 feet deep, or about 250 feet below the base of this section. This distance would bring the coal of this section near the Waynesburg horizon and probably represents the Little Waynesburg coal. The shales would be near the horizon of those worked at Spilman.

Chemical Analysis.—The shale from this pit has the following composition:

	Per cent.
Silica	54.52
Alumina	23.23
Ferric iron	4.80
Ferrous iron	2.23
Magnesium	1.71
Lime	0.97
Sodium	0.53
Potassium	2.94
Water	1.84
Titanium	0.82
Phosphorus	0.13
Loss on ignition	5.97
	99.69

"This shale burns red and has 13.18 per cent. of fluxing elements as compared with 17.11 per cent. in the Spilman shale.

"**Physical Properties.**—The clay slakes very slowly; it requires 25 per cent of water to develop a normal moulding consistency; its maximum plasticity is 11; its air shrinkage is 4½ per cent. The tensile strength is 102 pounds with a maximum of 117 pounds to the square inch. If dried rapidly the tensile strength is 54 pounds. Vitrification begins at

cone 1 (2102° F.) and is complete at cone 5 (2246° F.), with a shrinkage of 12 per cent."

The following is a description of the Magnolia Brick Co.'s plant at New Martinsville, Wetzel county, taken from report above referred to:

"Magnolia Brick Company.—This plant is located one mile east of New Martinsville on the Baltimore & Ohio Short Line railroad, and was started in 1892, one-half mile west, moving to the present location in 1903.

"The clay is molded in a Hercules machine of Horton Company with capacity of 40,000, run at half its capacity. The brick are dried in an eight-tunnel steam drier with capacity of 32,000, using the Scott car system. There are three temporary fifteen-arch up-draft kilns holding 180,000 brick each, burned with gas.

"The river clay at pit shows 25-foot face. It is tough, brownish in color, somewhat jointed, with streaks of gravel through it. The pit is just above the level of a small stream."

"Chemical Composition.—The following analysis shows the composition of the New Martinsville river clay:

	New Martinsville. Magnolia Works.
Silicia	65.35
Alumina	15.47
Ferric iron	6.48
Ferrous iron	0.29
Magesium	0.63
Lime	0.23
Sodium	0.71
Potassium	2.59
Water	2.08
Titanium	0.84
Phosphorus	0.31
Loss on ignition	4.93
	99.91

Mechanical Analysis.

	Range in millimeters.	Per cent
Fine clay	0.00 to 0.001	16.2
Coarse clay	0.001 to 0.005	7.3
Silt	0.005 to 0.020	32.1
Fine sand	0.020 to 0.150	35.6
Coarse sand	0.150 to 2.000	6.7
Water		2.1

"**Physical Properties.**—Both clays slake in one minute, require about 25 per cent. of water to develop the normal molding consistency, and have an air shrinkage of 4½ per cent. The maximum plasticity of the New Martinsville clay is 11, and of the Clarksburg, 20. The tensile strength of the former is 190 to 200 pounds, and of the latter, 180 to 185 pounds.

"The clay from New Martinsville reaches incipient vitrification at cone 1 (2102° F.) and complete vitrification at cone 5 (2246° F.) with a fire shrinkage of 8 per cent. and change of color from red to dark gray."

Tyler Brick & Tile Company.—This plant is located in the north edge of the town of Middlebourne, Tyler county, and was opened up in July, 1907. This company manufactures brick for building purposes and side walk paving. The clay is moulded in an American Machine Company's wire cut moulding machine, having a capacity of 15,000 bricks for a 10 hour day. Old fashioned open kilns are used for drying the brick, with natural gas being used for fuel. Two kilns are used, each with a capacity of 200,000, taking 15 days to dry ready for use in side walks and for building brick.

The **clay pit** is evidently partly in an old terrace deposit of Middle Island creek, a section of which is as follows descending:

		Feet.	Inches.
1.	Washington coal horizon		
2.	Old terrace deposit	5	0
3.	Shales, soft, greenish	8	0
4.	Fire clay, bluish to bottom	2	0

A fair quality of fire brick has been made from the 2 feet of clay at the bottom, and tool-dressers at the drilling wells in the vicinity find them all right for use in their furnaces in heating bits, etc. They fuse somewhat after a time, however. All brick is used locally and none shipped away. Mr. J. E. Sellers, Manager, is authority for data.

Along the Ohio valley attempts have been made without much success to manufacture brick from the draw slate below the "roof coal" of the Pittsburg bed. This draw slate

in the Marshall county mines resembles fire clay in texture and color. The writer collected two samples in different portions of the Hosack mine of the Hitchman Coal & Coke Co. at Benwood for analysis, the composition of which as reported by Prof. Hite is as follows:

Analyses of Draw Slate at Hitchman Coal Mine, Benwood.

	1st Sample. Per cent.	2nd Sample. Per cent.	Average. Per cent.
Silicia	57.84	59.20	58.52
Ferric Iron	1.82	1.69	1.76
Alumina	26.46	25.83	26.15
Lime	0.78	0.28	0.53
Magnesium	0.48	0.74	0.61
Potassium	2.16	1.63	1.89
Sodium	0.84	2.21	1.52
Titanium	0.96	0.64	0.80
Loss on ignition	7.09	7.13	7.11
Moisture	0.88	1.10	0.99
Totals	99.31	100.45	99.88

This draw slate runs from 10 inches to 3 feet in thickness, but it would be difficult to keep the clay free from fragments of coal which more or less mar the texture and color of the brick. The percentages of silica, ferric iron, lime, and alumina, revealed in the above analyses would seem to indicate that a fair quality of building brick could be made from this draw slate.

The writer collected a sample at the same mine of the "over clay" above the "roof coal," the clay ranging from 8 to 10 feet thick. The composition of this sample as reported by Prof. Hite is as follows:

Analysis of Over Clay Above Pittsburg coal, at Hitchman Mine, Benwood.

Silica	55.40
Ferric Iron	1.15
Alumina	28.73
Lime	0.81
Magnesium	0.13
Potassium	2.97
Sodium	1.06
Titanium	0.74
Loss on ignition	7.54
Moisture	1.18
Total	99.71

The above analysis shows a clay adapted to the manufacture of brick, but the same difficulty as above for the draw slate presents itself of keeping the raw material free from fragments of coal in case any attempt was made to utilize either of these clays in connection with the mining of the coal.

Pottery Clays.

No good deposits of pottery clay were observed in the Marshall-Wetzel-Tyler area. Along the Ohio river front at McMechen, Marshall county, Mrs. A. C. McMechen has made attempts to open up beds of pottery clay at two different horizons. The **lower bed** comes 10 to 15 feet over the Sewickley coal, and is about 2 feet thick, with thin silicious limestone in middle; the **upper bed** is 5 to 10 feet thick, coming 45 to 50 feet above the Sewickley coal. Both beds represent limy shale layers of the Benwood limestone. The writer collected a sample for analysis from each bed, the composition of which as reported by Prof. Hite is as follows:

Analyses of Clay on Mrs. A. C. McMechen Land, McMechen.

	Lower bed. Per cent.	Upper bed. Per cent.
Silica	35.63	28.84
Ferric Iron	0.98	2.22
Alumina	9.60	16.77
Lime	21.46	22.86
Magnesium	4.70	5.43
Potassium	1.72	1.26
Sodium	0.69	1.08
Titanium	0.30	0.29
Loss on ignition	23.97	20.85
Moisture	0.28	0.28
Totals	99.33	99.88

These analyses show that both beds run too high in Lime (Ca O) to be used for the manufacture of brick, pottery or fire brick. The range of lime in clays as given by Ries[3], is as follows:

3. New Jersey Geol. Survey, Vol. VI., page 64.

	Minimum. Per cent.	Maximum. Per cent.	Average. Per cent.
Brick clays	0.024	15.38	1.513
Pottery clays	0.011	9.90	1.098
Fire clays	0.030	15.27	0.655

It will readily be seen that the lime in both the McMechen samples far exceeds the maximum per cent. allowed.

The only **pottery industry** in the area is that of the Eljer Company located at Cameron, Marshall county, a description of which is found on page 17.

ROAD MATERIALS.

Within the boundaries of the Marshall-Wetzel-Tyler area probably occur the worst roads in the State of West Virginia. In the winter season the heavy haulage incident to the development of the many oil and gas fields renders the dirt roads almost impassable, hence the subject of road materials is of special interest to the residents of the three counties.

The subject of good roads has not been given the attention heretofore in this State that it deserves, but a very commendable act was passed by the Legislature, during its last session, creating the position of State Commissioner of Public Roads along with the provision for a Road Engineer for each county.

In northern Marshall county, limestones furnish a large supply of good road material. Nearly all varieties of limestone can be used in this work, but those which exhibit good wearing qualities along with the best cementing properties are preferred.

The neighboring county of Ohio, adjoining Marshall on the north, has set the rest of the State a good example to follow. Prof. G. P. Grimsley[4] has the following to say concerning Ohio county roads:

"In Ohio county of the Pan Handle area this subject of good roads has attracted attention for many years, and no

4. Ohio-Broooke-Hancock Report, pp. 291 and 292, W. Va. Geol. Survey.

county in the State has so large a proportion of its roads ballasted with rock. Of the 212 miles of road in the county, 200 miles, according to the chairman of the County Board of Commissioners, are macadamized. For the past ten years the county has appropriated $35,000 a year to keep these roads in good condition.

"This county is fortunate in the quantity and wide distribution of limestones, so that road material can be obtained at low cost convenient to the roads. The repair and construction of the roads are made under the direction of 31 supervisors, who reside in different parts of the county. The stone quarried, broken, and laid on the roads costs from 90 cents to $2.00 a yard, with an average cost of about $1.35. It requires about 12 yards of stone to 100 linear feet of road as used in this county."

The following limestone outcrop in the Marshall-Wetzel Tyler area:

Dunkard Series.	Monongahela Series.
Windy Gap Limestone	Waynesburg Limestone.
Nineveh Limestone.	Uniontown Limestone.
Washington Limestones.	Benwood Limestone.
Elm Grove Limestone.	Sewickley Limestone.
	Redstone Limestone.

The chemical composition, thickness and character of these limestones have already been taken up in the chapters on the geology of the Marshall-Wetzel-Tyler area. Only in northern Marshall county do the limestones appear to have much value for road material.

Windy Gap Limestone. This limestone is not sufficiently thick to pay for quarrying. Its thickness and distribution are taken up on pages 167-169.

Nineveh Limestone. This limestone has a wide distribution over Marshall and Wetzel counties, but appears to miss Tyler. It may furnish fair road material in Marshall, but is probably too silicious in Wetzel. On pages 178-182 is found a description of this stratum.

Washington Limestones. The Upper and Middle Washington limestones outcrop on many of the creeks of Marshall

and Wetzel counties. They are hard and durable and have been extensively used on the roads of Ohio county and also to a small extent in Marshall. Their composition, thickness and distribution are given on pages 207-213.

Elm Grove Limestone. This limestone comes over the Waynesburg coal and is quite friable and slaty, not having much value as road material. Its description is found on pages 247-249.

Waynesburg and Uniontown Limestones. These two limestones do not appear to have much value as road material. Their descriptions are found on pages 286-287 and 294-296 respectively.

Benwood Limestone. This limestone outcrops along Wheeling creek in northern Marshall and along the Ohio river front from the Ohio-Marshall county line south to near McMechen, and again at Powhatan station. Its thickness, chemical composition and distribution over the area are given on pages 297-301. This limestone is very popular for road material in Ohio county on account of its availability, and the ease with which it can be quarried and crushed, thus saving in labor and cost. Its lack of hardness, however, lowers its durability on roads, and it is soon ground to dust and mud. On account of its cementing properties, it might make good material to mix with the harder limestones, Redstone, Middle Washington, and others.

Sewickley Limestone. This stratum outcrops along the Ohio river front from the Ohio-Marshall county line south to McMechen, and a short distance up Boggs run. In some places it is hard and compact and would make good road material. Its thickness, chemical composition and distribution are given on pages 308-309.

Redstone Limestone. In northwestern Marshall county this limestone comes directly over the Pittsburg coal bed, and its outcrop extends along the Ohio river front from the Ohio-Marshall county line to near McMechen. It is compact and hard, making fine road material. On pages 311-312 is given a description of its thickness, chemical composition and distribution.

On pages 295-301 of the report of the Pan Handle counties of West Virginia, Prof. G. P. Grimsley gives an interesting account of the **Testing of Road Materials.** There are given physical tests of the Upper Washington, Middle Washington, Lower Washington, Benwood and Redstone limestones.

River and Creek Gravels. One of the greatest and cheapest sources of good road material in the Marshall-Wetzel-Tyler area and one that is frequently overlooked, is **gravel,** deposited along the Ohio river banks and the beds of its many tributaries within the three counties. It is already pounded and worn by attrition down to a size suitable for direct application to the surface of the road bed.

BUILDING STONE.

A general review of the building stones of West Virginia, with discussion of their origin, physical and chemical properties, and their uses may be found in Vol. IV of the reports of the West Virginia Geol. Survey.

The limestones of the area have already been described under the subject of road materials. Some of these harder and more compact limestones might be used for building stone, but the sandstones constitute by far the greatest source of building material.

The following sandstones outcrop in the Marshall-Wetzel-Tyler area:

Dunkard Series.

1. Gilmore Sandstone (Description given on pages 171-172).
2. Taylor Sandstone (Description given on pages 173-174).
3. Nineveh Sandstone (Description given on pages 174-175).
4. Burton Sandstone (Description given on page 182).
5. Fish Creek Sandstone (Description given on pages 185-187).
6. Rush Run Sandstone (Description given on pages 191-192).
7. Hundred Sandstone (Description given on pages 214-215).
8. Upper Marietta Sandstone (Description given on pages 215-218).
9. Lower Marietta Sandstone (Description given on pages 215-218).
10. Mannington Sandstone (Description given on pages 226-230).
11. Waynesburg Sandstone (Description given on pages 245-247)

Monongahela Series.

1. Gilboy Sandstone (Description given on pages 287-288).

The only sandstones in the above list that have been quarried to any extent for building purposes in the Marshall-Wetzel-Tyler area are the **Fish Creek, Hundred, Upper Marrietta, Lower Marrietta, Mannington,** and **Gilboy.**

Fish Creek Sandstone.

This stratum comes immediately over the Fish Creek coal. Its stratigraphy, thickness, and distribution are fully described by the writer on pages 185-187. A large quarry has been opened up in this rock on the north side of the B. & O. R. R. near the mouth of Wolf run above Littleton, Wetzel county. Prof. G. P. Grimsley gives the following account of this quarry in Vol. IV, pages 427 and 572.

"**Littleton Stone Company at Littleton, Wetzel County.** Littleton is located in Wetzel county on the main line of the Baltimore and Ohio railroad, 42 miles east of Wheeling. B. F. Connelly has opened a quarry about one mile east of town near the top of the high hill. The stone is carried down an incline to a small railroad which connects with the B. & O. road. The stone was first opened about 1899, and the present quarry has been in operation three years. Ten to twenty-five men are employed and three car loads of stone shipped daily during the working season. The stone has been used in various cities east and west along the B. & O. railroad, and a large quantity has been used in the railroad construction. The stone for the annex to the Moundsville penitentiary came from this quarry.

"**Quarry.** An oil well drilled on top of this sandstone reached the Pittsburg coal at 810 feet. This interval would place the stone about the horizon of the Fish Creek sandstone of Stevenson.

"The quarry face runs N. 30° W. and is 400 feet long and worked back 60 feet in the present quarry. The outcrop shows nearly a mile of stone around the hill.

"The section of the quarry is as follows:

	Feet.
Shales and soil cover	16
Shaly sandstone	6
Main sandstone ledge (brown in color)	28
Blue flaggy sandstone	20

"The sandstone, blue and brown in color, continues 30 to 50 feet below the bottom of the working quarry. The joint planes run N. 30° W. and N. 50° E."

"Littleton Stone Company.—From J. A. Connelly, Littleton, Wetzel County, West Virginia. Geological Horizon — Fish Creek Sandstone.

"Ends were finished flat and were tested without plaster or other facing.

"Samples prepared by finishing on a rubbing bed, and tested at Watertown Arsenal."

Compression Tests.

Description	Dimensions. Hgt.	Comp'd Surface.		Sectional Area.	First Crack	Ultimate Strength. Total.	Per Sq. In.
	Ins.	Ins.	Ins.	Sq. Ins.	Lbs.	Lbs.	Lbs.
Buff, (Brown)	3.89	3.88	3.88	15.05	112,200	122,000	8,110
Buff, (Brown)	3.72	3.80	3.80	14.44	89,000	97,000	6,720
Buff, (Brown)	3.86	3.87	3.87	14.98	119,800	119,800	8,000
Buff, (Brown)	3.77	3.79	3.79	14.36	110,600	110,600	7,700
Buff, (Brown)	3.85	3.85	3.85	14.82	105,000	105,000	7,090
Buff, (Brown)	3.82	3.82	3.82	14.59	117,100	117,100	8,030
Gray, (Blue)	3.82	3.82	3.81	14.55	197,200	197,200	13,550
Gray, (Blue)	3.82	3.82	3.83	14.63	192,600	192,600	13,160
Gray, (Blue)	3.83	3.82	3.82	14.59	205,000	206,000	14,120
Gray, (Blue)	3.64	3.63	3.63	13.18	199,800	199,800	15,160
Gray, (Blue)	3.65	3.65	3.65	13.32	111,200	111,200	8,350
Gray, (Blue)	3.80	3.79	3.84	14.55	119,000	121,000	8,320
Gray, (Blue)	3.78	3.81	3.81	14.52	119,200	119,200	8,310

Transverse Test—Gray Stone.
(U. S. Geological Survey).

Breadth Inches.	Depth. Inches.	Span. Inches	Modulus of Rupture. Pounds.
6.00	3.85	20	840
5.98	3.85	20	850
5.80	3.90	20	1,718
Average			1,136

Transverse Test—Buff Stone.
(U. S. Geological Survey).

Breadth. Inches.	Depth. Inches.	Span. Inches	Modulus of Rupture Pounds.
5.99	3.90	20	600
5.88	3.81	20	620
6.00	3.84	20	750
Average			657

Hundred Sandstone.

The Hundred sandstone comes directly under the Lower Washington limestone and has been quarried for building purposes a short distance below Hundred, Wetzel county (See page 214). Prof. G. P. Grimsley gives the following account concerning this quarry in Vol. IV, pages 428 and 581. In 1908 the quarry was abandoned and switch removed:

"**Batson and Company Quarry at Hundred, Wetzel County.**—The town of Hundred is four miles east of Littleton on the Baltimore and Ohio railroad. Batson and Company of Moundsville in 1904 opened a sandstone quarry one mile west of Hundred or 15 miles west of Mannington. The stone was used by the B. & O. for bridge piers and was shipped to various cities for building stone.

"**Quarry.** The Jollytown coal outcrops a few feet above the creek level at this place and just below the sandstone, which would make the horizon the Dunkard[5] Sandstone.

"The face of the quarry runs east and west 200 feet long and worked back 40 feet. The stone in blue and buff in color. The blue stone is fine grained, strongly laminated with some white but more black mica flakes. The brown stone is made up of small quartz grains loosely cemented and rather porous, with few scattered white mica scales and some white kaolin particles.

"The bottom of the quarry is 18 feet above the creek level and a section shows.

	Feet.
Buff shales	20
Shaly sandstone	3
Sandstone, blue and buff	25

"There are no well defined joint planes."

A photograph of this quarry is given in plate VII., p. 214.

"**Microscopical Structure.** A thin section of the Hundred quarry sandstone was examined under the microscope by Mr. S. L. Powell of Johns Hopkins University, who reports as follows: 'The original material of this rock was a

5. The writer has named this the Hundred sandstone (see page 214), belonging below and not above the Jollytown coal.

mixture in about equal proportions of grains of quartz, feldspar, kaolin, mica (biotite), together with more or less argillaceous matter. These minerals except the quartz, have undergone extensive alteration. The feldspars may be seen in every stage of decomposition. A few of them are fresh enough to show twinning lamellae, others are changed to kaolin, and yet others entirely changed to a fine mosaic of alteration products chiefly muscovite, chlorite, and kaolin. But little of the original mica remains, the change having been chiefly to iron oxide which is abundant.

" 'The quartz grains vary from rounded to more or less angular forms, and in many instances are cemented by silica into compact areas. Around such areas and individual grains as well, there is a coating of iron oxide with kaolin which frequently fills the interspaces between the grains. The matrix is partly silica, partly oxide of iron and kaolin with a considerable amount of argillaceous material. The grains would average about 0.45 millimeter in diameter.' ".

"Hundred Sandstone Quarry.—From W. H. Batson & Co., (formerly Mountain State Stone Co.) Hundred, W. Va. Geological Horizon—Dunkard Sandstone. Ends were finished flat and were tested without plaster or other facing. Samples prepared by finishing on a rubbing bed, and tested at Watertown Arsenal."

Compression Tests.

Description.	Dimensions.			Sectional Area.	First Crack.	Ultimate Strength	
	Hgt.	Comp'd Surface.				Total.	Per Sq. In.
	Ins.	Ins.	Ins.	Sq. Ins.	Lbs.	Lbs.	Lbs.
Buff	3.91	3.96	3.95	15.64	134,200	134,200	8,580
Buff	4.00	4.02	4.00	16.08	139,900	139,900	8,700
Buff	3.98	4.03	4.02	16.20	106,200	106,200	6,560
Buff	3.82	3.81	3.81	14.52	94,000	94,000	6,470
Buff	4.00	4.02	4.02	16.16	139,800	139,800	8,650
+ × Buff	3.92	3.93	3.93	15.44	134,000	134,000	8,680

Transverse Test.

(U. S. Geological Survey).

Breadth. Inches.	Depth. Inches.	Span. Inches	Modulus of Rupture. Pounds.
5.95	3.99	20	680
5.85	3.94	20	920
5.87	3.94	20	860
Average			820

Lower Marietta Sandstone.

This stratum comes directly over the Washington coal and is fully described on pages 215-218. At the present time it is being quarried along the river hill below New Martinsville. Prof. G. P. Grimsley gives the following account of this quarry in Vol. IV, pages 439-440 of the State Survey reports:

"**Harbison Quarry at New Martinsville, Wetzel County.**

—The Harbison sandstone quarry is located two miles below the town of New Martinsville, just above Sardis on the Ohio river and near the electric car track over which the stone is hauled to town The stone has a very uniform texture. It is composed of small quartz grains, with mica flakes scattered through. It has a buff to yellowish brown color, but weathers to a lighter shade bordering on a gray tone.

"**Quarry**...The face of the quarry runs east and west and is worked to the south with a present width of about 25 feet. Six men are employed and 100 perch were quarried during the summer of 1907. The Washington coal comes just below the sandstone and was formerly mined on a small scale. A section of the quarry shows:

	Feet.
Red shales	12 to 20
Hard sandstone	3
Buff sandstone	12 to 15

"The joint planes run north and south and N. 80° W. Between the latter planes the distance is 8 to 10 feet.

"Further south large blocks of this sandstone[5A] have rolled down the hillside and are there blasted for rubble stone. At this place the stone is fine grained, silvery in lustre due to the abundant white mica flakes. It is also quite flaggy so that it readily splits into smooth blocks."

5A. The writer believes these large blocks have rolled down from the stratum identified as the Fish Creek in the section at this point on page 101.

Gilboy Sandstone.

The only quarry of any consequence in Tyler county is the one located along the turnpike at the east edge of Sistersville. Prof. G. P. Grimsley gives the following account of this quarry in Vol. IV, page 445 of the W. Va. Geol. Survey reports:

"**McCabe Quarry at Sistersville, Tyler County.**—A sandstone quarry was opened about 12 years ago on the hill at the east end of the town of Sistersville near the Ohio river. It has been operated for the past two years by George McCabe for local trade. The quarry is now worked back almost to the lot lines. The horizon appears to be that of the Waynesburg[6] sandstone.

"**Quarry.** The face of the quarry is 150 feet long and it has been worked back 30 to 40 feet. The stone shows a strong dip to the east. As this stratum is followed north or south, it is claimed to be harder and more difficult to work, and is apt to be banded by silver streaks due to mica.

"The quarry floor is 54 feet above the Baltimore and Ohio railroad track in the town, and a section shows:

	Feet
Soil and shales	10
Fine shales	3
Sandstone ledge	2
Sandstone ledge	2
Sandstone ledge	6
Shaly sandstone	3
Greenish and black shales.	

"The joint planes run N. 50° W. and N. 20° E."

6. The writer has identified this stratum as the Gilboy and not the Waynesburg (See pages 121-122 and 287-288).

CHAPTER XI.

SOIL SURVEY OF THE MIDDLEBOURNE AREA, WEST VIRGINIA.

(Marshall, Wetzel and Tyler Counties.)

By THOMAS A. CAINE, E. R. ALLEN, H. JENNINGS, and G. W. TAILBY, JR.

DESCRIPTION OF THE AREA.

The Middlebourne area is located in the northwestern part of West Virginia and includes Tyler, Wetzel, and Marshall counties, the last-named being the extreme southern county of the Panhandle. The area is bounded on the north by the Ohio River and Ohio County, on the east by Pennsylvania, and Monongalia and Marion counties, on the south by Harrison, Doddridge, Ritchie, and Pleasants counties, and on the west by Pleasants County and the Ohio River. In a north and south direction it has a length of about 45 miles, while east and west its width varies from about 12 to 32 miles. Parallel 39° 20′ crosses the southern part of the area and 40° the northern part and meridians 80° 25′ and 81° 10′ west of Greenwich form the eastern and western limits, respectively. There are 609,536 acres or about 952 square miles in the area[1].

The most conspicuous topographic feature of the area is the narrow, meandering, gorgelike valley of the Ohio River, which extends in a northeast-southwest direction along the entire western border. The elevation of the river varies from 581 feet at the southern boundary to 610 feet at the

1. About 22 square miles of this was surveyed in the Wheeling area, but is included in the present map to complete Marshall County.

northern boundary. The alluvial and terrace lands along the river are seldom over a mile wide, and as the river meanders back and forth the bottoms are found first on one side and then upon the other side of the stream. The hills bordering the river are steep and abrupt, and at those points where the channel runs close to the valley wall they are usually precipitous, often rising to an elevation of 400 to 600 feet in a distance of from one-fourth to three-fourths mile from the river.

Viewed from the hilltops the whole region presents a picturesque appearance, resembling a mountainous country in miniature. A close inspection, however, will show that as as far as can be seen in all directions the highest points are all on about the same general level; and looking from one of the highest points, a mile or so back from the river across into Ohio, the deep, gorgelike, intervening valley is hardly perceptible. These nearly horizontal hilltops are the remnants of an ancient upland plain which has been reduced to its present highly dissected form by centuries of weathering and erosion.

The drainage of the area is all into the Ohio River, principally through Wheeling, Grave, Fish, Fishing, and Middle Island creeks. These creeks all pursue roughly parallel northwestern courses, but make a sharp bend to the southwest just before entering the river. They are very crooked and wind back and forth, often making loops of a half mile or so across. These creeks are still deepening their channels to the level of the Ohio River. In an air-line direction they have average falls varying from 15 to 30 feet per mile. In places their channels rest upon bare rock. On the inner bends of the loops there are often narrow strips of rich alluvial land and the hills back of these are less precipitous than on the outer bend, where erosion is more active. Here the hills are steep and precipitous, and whenever there happens to be a heavy, massive stratum of sandstone high up in the hills, it usually breaks off in huge, angular blocks, with which the hillside and the creek bottoms below are strewn.

Frequently within the loops of these large streams and a hundred feet or more above their present channels the same heavy, massive sandstone stratum, because of its resistance

to weathering, forms a distinct table land, and gives rise to a peculiar character of soil. These larger creeks all have high valley walls with steep, sloping sides, and are, if anything, more gorgelike than the Ohio Valley. The hills rise abruptly from 200 to 400 feet a short distance back from the streams.

The drainage basins of the large streams are made up of an irregular network of smaller streams, which usually flow on bedrock through straight, deeply-carved V-shaped channels. The depth of these valleys varies from 100 to 300 feet, and the fall per mile of the streams is often greater than 100 feet. The streams are rapidly cutting their channels deeper, hence there is seldom any bottom land along their courses. The main roads often lie in these valleys. In some places the valley floors are so narrow that the stream beds are utilized as the road, and where the stream ends the road winds up to the top of the divide only to descend immediately into the next valley. In the central portion of the area the divides between the main drainage basins are narrow and winding, the streams on both sides having cut back so far as to interlock, resulting in the formation of a series of long, narrow, detached hills and knobs along the top of the divide. In this same portion of the area the ridges between the smaller creeks and branches are long, narrow, and angular. In the northern and southern portions of the area, however, the divide between the main drainage basins and the ridges between the smaller streams are broader, the knobs and hills are less conspicuous, and the region is much better adapted to general farming. One of the highest points in the area is Honsocker Knob, which has an altitude of about 1,625 feet, so that within the area there is a total range in elevation of over 1,000 feet.

The first permanent settlers in the area came from Virginia, Maryland, and North Carolina about 1775, and located at different points along the Ohio River, principally near the present sites of Moundsville and New Martinsville. For the first fifty years following 1775 many more came from the same States, being attracted by the rich lands and the transportation advantages afforded by the Ohio River. The present farming population, comprising about 60 per cent of that

of the whole area, is mainly descended from the original settlers, with a sprinkling of those of German and Irish extraction. The remainder of the population are those who, being attracted by the good wages paid in the oil, gas, coal, glass, pottery, and iron industries along the river, have come in recent years from various parts of this country and of the Old World.

When the original thirteen States were organized the area fell within the territory of Virginia and remained a part of that State until the formation of West Virginia in 1863. The whole area was originally within the limits of Ohio County, which was organized in 1785 and at that time included not only all of the Panhandle, but extended indefinitely westward and for a considerable distance to the south. After the formation of the State of Ohio the westward extension of Ohio County, Virginia, became fixed by the Ohio River. In 1814 Tyler County, named in honor of President Tyler's father, was formed from a part of Ohio County and included what is now Tyler and Wetzel counties. In 1835 Marshall County, named in honor of John Marshall, was organized from the southern portion of Ohio County. In 1846 Wetzel County was formed from a part of Tyler County by act of the Virginia assembly. All three of these counties have an excellent frontage on the Ohio River, and thus even before the advent of railroads they were favored with the best means of transportation that the time afforded.

Until about twenty years ago little had been done to develop the natural resources of the area. Since then petroleum and natural gas have been found in vast quantities and are being extensively developed in the southeastern part of the area, while in the northern part along the Ohio River the iron, steel, and glass industries are yearly becoming more important. In recent years the growth of the towns along the Ohio River has been rapid, and some new towns have sprung up, this being especially true in the vicinity of the iron, steel, and glass plants. The original forest growth of the area has practically all been removed, though in the central portion, where much of the land is too steep, broken, and rough even

for profitable use as pasture, the landowners have very wisely permitted large areas to become reforested.

The superior shipping facilities afforded by the Ohio River have been and always will be an important factor in the development of the region, and at present there are several steamboat landings within the area. There are also many desirable sites along the river for the location of steel, iron, glass, and pottery plants or factories. The Ohio River division of the Baltimore and Ohio Railroad runs the full length of the area on the West Virginia side of the river and connects the towns of Moundsville, New Martinsville, and Sistersville with Wheeling on the north and Parkersburg on the south. The West Virginia Short Line of the Baltimore and Ohio system crosses the southern part of Wetzel County, connects New Martinsville with Clarksburg, and the Wheeling Short Line, which crosses Marshall County and a part of Wetzel County, connects Moundsville with Fairmont. There are also two trolley lines in the area, one extending from Moundsville to Wheeling and the other from Sistersville to New Martinsville.

The chief towns of the area are McMechen, Moundsville, New Martinsville, and Sistersville, all of which are located on the Ohio River. There are also several other thriving little towns, the largest of which are Cameron, Hundred, Middlebourne, Pinegrove, Jacksonburg, and Smithfield. These towns and Wheeling furnish a greater demand for general farm and dairy products and truck crops than is at present being supplied by the agricultural population of the area.

Climate.

The climate of the Middlebourne area is well suited to the carrying on of general farming. The winter weather is cold and there is often considerable snow, but it can not be said that the climate is severe. It is seldom that the temperature goes below zero, and the average for the three coldest months—December, January, and February—is about 32° F. The other extreme is rarely higher than 100° F.

The average length of the growing season is between

six and onehalf and seven months, and not infrequently stock may be pastured for eight months of the year.

According to the data given in the accompanying table for New Martinsville, the average annual precipitation is about 39 inches, and during October and November the average monthly rainfall is about 2.7 inches. This is sufficient to germinate wheat and rye and get them well started and rooted before the winter sets in. The table shows also that the average monthly precipitation for December, January, and February is about 3 inches. A considerable part of this is in the form of snow, which protects the ground from much hard freezing and thawing. April has an average rainfall of 3.4 inches, and May is usually warm and pleasant, with an average rainfall of 3.5 inches, which is sufficient to germinate the corn and oats. It is seen also that in June, July, and August the average monthly temperature is about 74° F. and that the average monthly precipitation is about 4 inches. This is ample warmth and moisture for the growing and maturing of oats, wheat, rye, and hay. The least precipitation occurs in the fall after the close of the growing season, while the greatest occurs when the growing crops need it most. A failure of the staple crops on account of drought is very rare, and it is likewise very seldom that the rains are so excessive during the spring and summer months as to prevent the completion of plowing and sowing or seriously to damage hay and grain during harvest.

Normal Monthly and Annual Temperature and Precipitation.

Month.	New Martinsville.		Central Station. [2]		Bens Run [2]	
	Temperature.	Precipitation.	Temperature.	Precipitation	Temperature.	Precipitation.
	° *F.*	*Inches.*	° *F.*	*Inches.*	° *F.*	*Inches.*
January	32.0	3.12	37.0	3.60	38.3	3.42
February	30.7	2.96	30.6	1.46	32.0	2.10
March	42.7	3.32	35.7	3.98	37.2	5.06
April	52.9	3.44	52.6	3.18	54.6	3.62
May	63.6	3.54	61.9	2.00	64.0	6.89
June	72.1	3.85	70.1	4.58	72.4	5.82
July	75.8	5.42	71.6	3.32	74.7	3.27
August	74.9	2.93	75.2	4.72	77.7	8.62
September	68.0	2.42	69.0	2.76	72.0	1.64
October	56.0	2.09	54.3	1.86	55.8	3.22
November	44.1	3.35	42.5	2.34	44.7	2.52
December	34.8	3.19	35.0	4.51	35.8	5.60
Year	54.0	39.63	53.0	38.25	54.9	51.78

2. The figures given for Central Station and Bens Run represent the temperature and precipitation for the year 1906, without departures from the normal.

Dates of First and Last Killing Frosts.[3]

Year.	New Martinsville		Wheeling.	
	Last in spring.	First in fall.	Last in spring.	First in fall.
1898	May 9	Oct. 24	Apr. 8	Oct. 28
1899	Apr. 10	Oct. 1	Apr. 5	Oct. 1
1900	May 4	Oct. 17	Apr. 10	Nov. 14
1902	Apr. 15	Oct. 15	Apr. 8	Oct. 22
1903	Apr. 24	Oct 25	Apr. 5	Oct. 25
1904	Apr. 22	Oct. 7	Apr. 21	Oct. 28
1906	May 10	Oct. 12	May 7	.....
Average	Apr. 26	Oct. 14	Apr. 13	Oct. 25

Agriculture.

The early settlers confined themselves largely to the Ohio bottoms and to the easily tillable land for a few miles back from the river. They found the soil very well adapted to wheat, corn, and rye, and the growing of these crops constituted the main type of farming for the first fifty years following 1775. Over the larger portion of Wetzel and Tyler counties, however, there are large areas, especially within the drainage basin of Fishing Creek, where the hills are so steep and the ridges so narrow that the land has remained in the original forest or the areas once cleared have been reforested. It is within this poorest agricultural portion of the area that great bodies of oil and gas have been exploited in recent years.

During the first quarter of the last century the production of wheat, corn, and rye outgrew the local demands, but with the establishment of river transportation with the older colonies of the lower Mississippi a large flour and whisky trade was built up.

About 1840 grain growing is said to have become unprofitable because of the constant improvident cropping of the soils. The wheat yields had fallen off year after year from 35 bushels to about 10 bushels per acre, and other grain crops had decreased in like proportion. Considerable land

3. Data of frost occurrence at Central Station and Bens Run were too fragmentary to have any significance and are therefore omitted from above table.

was abandoned as "worn out" and allowed to grow up to weeds and brush, and for a time the production of grain scarcely sufficed to supply the local demands.

About this time (1835) a number of Merino and Saxony sheep were introduced, and the industry was so profitable that it spread in all directions and became very important in Virginia, Pennsylvania, and Ohio. Nearly every farmer kept some sheep and a number of those who owned large flocks became comparatively wealthy. Wool answered the commercial requirements of the time, since it was not exceedingly bulky, could be handled easily, was nonperishable, and in great demand. The wool or the manufactured woolen products were readily exchanged in the southern markets for sugar, molasses, and cotton. Some of the area has always been considered a little too steep and broken for heavy stock, but admirably well adapted to sheep raising, which for a number of years was the most important industry, little attention being paid to other lines of agriculture. It was found that after being pastured to sheep a number of years the "worn-out" soils were greatly benefited, and some claim that they became more productive than ever. By this time the whole region had made marked progress in settlement and in industrial enterprises, and with the increase in population there arose a great demand for all kinds of farm produce, especially dairy products, fruit, and truck crops. A reduction in the price of wool caused sheep raising to become less popular and the wool industry no longer constitutes the principal pursuit. However it is still an important auxiliary to general farming, especially among the most progressive and prosperous farmers, who use this means of maintaining the productivity of their soils.

Taking the area as a whole, there has been no increase in the acreage of wheat, corn, and oats during the last twenty years, and in fact the acreage seems to have been reduced within the last ten years, notwithstanding the ruling higher prices of these products. In the vicinity of Wheeling, Moundsville, New Martinsville, and some of the other towns a few of the farmers are striving to supply the increasing local demand for milk and butter, fruit of all kinds, and truck

crops. There are no commercial orchards within the area, but judging from the few scattering, poorly kept orchards, and also from the similarity of climate and soils to those in the northern end of the Wheeling area, where there are several successful commercial orchards, there can be no doubt that the soils along the Ohio River, as well as most of the soils found in the hill sections of the area, are well adapted to the production of such varieties of apples as the Stark, Ben Davis ,and Rome Beauty. It is also recognized that a considerable part of the upland areas is well adapted to dairying, but owing largely to the confining nature of the occupation, lack of intelligent labor to handle the stock, and the steep, rough roads to market, this industry is limited to the farms convenient to towns. The more level upland soils are fairly well and the terrace soils along the Ohio River admirably adapted to truck and berry crops, as well as to general farming. At present, however, very little attention is being paid to trucking in either of these localities, and most of the fruit and vegetables sold in the larger towns along the river is shipped in from outside points.

On the upland farms the more level part is usually fenced off from the steeper hillsides and used for general farm crops. The steeper hillsides are usually seeded down to grass and used for pasture or the production of hay. Some of these hillsides have been furnishing excellent pasturage for over twenty-five years. Below these pasture fields and adjacent to the streams on both sides there is usually considerable Rough stony land which affords scant pasture and which is often permitted to grow up to locust and other trees or to remain covered with its original forest growth. In the central portion of the area most of the steep slopes and narrow ridges remain in timber.

The usual crop rotation upon the tillable uplands is one year each of corn, oats, and winter wheat. A limited acreage of potatoes is grown. Timothy is sown in the fall with the wheat, and clover is sown the following spring. The first year the meadow consists largely of clover, but the following year the timothy predominates and is left as long as it will yield a profitable crop, usually from three to five years.

On the soils derived from calcareous shales, as the timothy thins out Kentucky bluegrass takes its place. The latter is never cut for hay, but makes excellent pasture, being much better than the Canadian bluegrass, which is also abundant in the area. The length of time a field remains in pasture depends upon the size of the farm, the amount of stock kept, and very much upon the location of the field and the character of the soil. The most successful farmers try to keep land seeded down as long as possible, and to keep enough stock to consume the greater part of the hay, straw, and grain.

There are a few custom flour mills in the area, but practically all of the farmers sell their wheat and buy flour imported from other States. This has led a few to abandon wheat growing and to substitute a yearly rotation of corn and oats. Timothy and clover are sown in front of the drill with the oats, and usually two excellent crops of clover are secured the next year. In the cultivation of the steeper slopes the farmers, as a rule, cultivate the upper half one year and the lower half the following year. This is done to keep washing and gullying in check, and whatever wash occurs from the upper half of the field the first year is caught in the grass and sod of the lower half of the field and adds to its fertiliy for the following year. When the steeper slopes are broken for corn the best farmers leave one and sometimes more narrow strips of sod about the middle of the field and following the contour of the hill; and where there are slight depressions, old gullies, or little runs they are likewise left in sod, and the brush and stones which accumulate in the field are usually disposed of by dumping into these depressions to aid in checking further gullying and erosion.

On many of the slopes of the Rough stony land the influence of the underlying more resistant shaly sandstone is quite marked, giving rise to a series of horizontal natural terraces. The level part of the terraces consists of a narrow strip of very productive soil, while the part too steep for cultivation is kept in sod for the protection of the better lying strips.

Very little commercial fertilizer is used, but all of the farmers recognize the great value of stable manure in maintaining the productivity of the soils. Many admit that it would be better for their farms if they kept more stock. In the trucking areas no rotation is practiced, and the productivity of the soils is maintained by manure hauled from the towns. The level areas along the streams are not subject to serious erosion and their productivity is maintained by occasional overflows and by frequent heavy applications of manure.

The adaptation of the methods to the present conditions on the rolling uplands is well illustrated in the case of the corn, practically the only clean-cultivated general farm crop in the area. The sod is broken to a depth of about 7 inches, and the corn is either drilled or dropped in rows running with the contour of the hills, so as to aid in checking erosion. During the first year the sod roots aid in binding and holding the soils, and recognizing this fact the farmers seldom plant corn two successive years upon the same field, because the sod roots would be thoroughly rotted the second year and washing and gullying would be serious.

The low prices paid for wool, the rapid industrial development of the region, and the increased demands for agricultural products have completely changed the agriculaural conditions during the last quarter of a century. Landowners throughout the area are quite prosperous, as shown by the low percentage of mortgaged farms. Their dwellings and barns are usually quite substantial, the farms are well supplied with good draft horses, and there is an abundance of up-to-date farm machinery in use. In recent years returns from the sale of the underlying coal and the rentals and royalties from gas and oil have added to the income of the farmers, and their prosperous condition at present is due in part to this.

The great demand for laborers in the factories, mills, potteries, blast furnaces, and mines, and in the oil and gas industries has attracted many people from adjoining States and caused young men to leave the farms to engage in these various pursuits because of the shorter hours and better pay.

The scarcity of good farm labor is one of the most serious drawbacks to farming. The wages paid farm hands range from $20 to $30 a month, with board, lodging, and washing, and often feed for a driving horse. The most successful farmers feel the necessity of arranging their farm practice in such a way as to hire as little labor as possible. About 75 per cent of the farms are operated by the owners, the remainder being rented for cash or on shares. Throughout the area, especially in the central part, there are considerable tracts of wooded land which are too steep and broken for cultivation. The average size of the farms is about 100 acres. The size of the holdings, however, ranges from a few acres to over 1,000 acres.

There has been a great increase in the selling price of the farm lands within the last fifteen years. Improved farms are now selling for as much per acre without the coal, oil, or gas privileges as they did fifteen years ago with all of these privileges. Unimproved farm lands with the above-mentioned rights could have been purchased fifteen years ago for about $15 an acre. With the coal, oil, and gas privileges these same lands now bring from $50 to $100 an acre, depending upon location. In the best farming sections of the area the average price per acre for improved farms without coal, oil, or gas rights is about $50. The price, however, varies considerably, depending upon the kind of soil and the nearness of the farm to town.

At present the live-stock interests of the area are not as important as formerly. Some cattle, sheep, and hogs are kept by every farmer, but on most farms the number could be profitably increased. The stock is usually of good quality, including the farm horses, which are well bred and well cared for.

Until about twenty-five years ago the production of sheep for wool or mutton was one of the most important industries. At present there are about one-third as many sheep in the area as formerly. Practically the only breeds raised are the Delaines and the Merinos. These give a good yield of wool, and the lambs, which are marketed in the fall,

bring from $2 to $3 a head when six months old. It is believed that the number of sheep could be profitably increased where protection from dogs can be had, and also that goats would prove a good investment in the rougher parts of the survey.

The dairy interests are confined almost exclusively to the territory immediately surrounding the towns and villages. Not many blooded cows are kept. The dairymen usually live close to town and retail milk at 5 to 8 cents per quart, the price depending somewhat upon the season of the year. The present local supply of milk is barely sufficient to meet the demand in some of the towns and it seems that this industry could be profitably extended.

Some farmers sell annually in the local markets a few fat steers and calves. Only a few hogs are raised, but in parts of the area where corn is grown in abundance more hogs could be raised with profit.

As a rule, the farmers understand how the different soils should be handled to maintain their productivty and to bring the largest returns. On the Meigs clay loam the fields should seldom if ever be plowed, and it would be better to keep them either in orchards or pasture. On the Rough stony land it is believed that the greatest profits are to be had by pursuing systematic forestry, and that growing locust trees for posts would be especially profitable. Orcharding should receive more attention. Practically all of the farmers recognize that it would be better to keep more stock and feed their roughage at home instead of selling, even at high prices, all available hay, straw, and grain to the teamsters in the oil and gas fields.

Soils.

The soils of the area fall naturally into three general divisions. The first and most important is that comprising the residual upland soils, which occupy fully 90 per cent of the area, and are found in all locations form the gently rolling hilltops to the steepest hillsides. Geologically, the up-

lands belong to the Coal Measures of the Carboniferous age, and that part of the Coal Measures here represented belongs to the Dunkard series (Permian.) Several upland soil types were found, each differing from the others in texture, topography, and agricultural value, and each requiring different methods of treatment in the way of cultivation and fertilization in order to insure the best yields.

The Dunkard series is composed largely of a brown and a gray micaceous sandstone which is very easily disintegrated. In Marshall County these sandstones are interstratified with limy shales, which upon weathering result in soil of relatively high lime content, and for this reason, as also because of the more gentle topography, the soils are considered better for general farming than those farther south.

In Wetzel County, especially, the sandstone and sandy shales are interstratified with numerous beds of marly red shales, holding concretions of lime, and because of the easily eroded character of these formations they give a very rugged topography and are better suited to forestry, grazing, and fruit culture than to general farming. Large areas of this region are forested with second-growth timber, nearly all of the original timber having been removed. Occasionally small cleared spots may be seen even upon some of the steeper slopes, and for the first year or two the crop yields upon these are surprisingly large, but unless kept in pasture the soil soon washes off and exposes the underlying shales and sandstone.

In the region where the limy shales are most abundant the soils are best for wheat, corn, oats, hay, and pasture and support a permanent bluegrass sod. The soil derived from the marly red shales is also well adapted to these crops and supports an excellent bluegrass sod, but owing to rapid erosion it is found only in narrow areas, a rod or so wide, running horizontally around the hills. Very often the sandstone and sandy shale fragments from above have become so thoroughly mixed with this soil that it is difficult to recognize it. The soil derived solely from sandstone is limited in extent and occurs as isolated patches, principally in shelf-like positions 100 feet or more above the main streams.

The second of the three general divisions of soils found in the area occurs in the form of terraces along the valleys of the Ohio River and its larger tributaries. Along the river the terrace material is composed largely of glacial sand, silt, and gravel brought down by the glacial floods. Along the tributary streams, however, the terrace material, though deposited at the same time as the river terraces, was not brought from a glaciated region, but was derived from the soft, easily weathered sandstones of the Dunkard series, and hence the difference in the resulting soils.

The terrace soils of the Ohio River are represented by the Wheeling gravelly loam, the Wheeling sandy loam, and the Wheeling silt loam, while the terraces of the tributary streams are represented by a single type, the Tyler silt loam.

The third division of soils comprises the recent alluvial deposits in the valleys of the Ohio River and its larger tributary streams. The resulting soil types are the Huntington loam and the Huntington fine sandy loam. The latter occurs in narrow strips bordering the river and represents areas where the coarser materials, such as sand and vegetable matter, were deposited in times of flood. The Huntington loam is often found farther back from the stream areas where the finer materials—fine sand, silt, and clay—were deposited by quieter currents. In the Ohio Valley these two soil types, as shown by various excavations, are found as a veneer over the sandy and gravelly terrace materials.

Along the small tributary streams only patches of soil are found, and these are usually too small to be shown upon a map of the scale used. Along the larger streams, such as Wheeling, Grave, Fish, Fishing, and Middle Island creeks, there is considerable bottom land. The channels of these streams are nearly level with the Ohio River, and the valleys in places are a half mile or more in width. The bottoms are all subject to overflow, and the soil formed there, though often rather variable in texture, is a loam having the characteristics of Huntington loam.

The following table gives the names and the actual and relative extent of the different soil types:

Areas of Different Soils.

Soil.	Acres.	Per Cent.	Soil.	Acres.	Per Cent.
Meigs Clay loam	281,280	46.2	Wheeling gravelly loam	2 240	0.4
Rough stony land	263,104	43.1	Upshur Clay	1,856	.3
Huntington loam	25,152	4.1	Brooke Clay loam	1,024	.2
Dekalb loam	24,512	4.0	Huntington fine sandy loam	640	.1
Dekalb silt loam	3,712	.6	Wheeling sandy loam	192	.0
Tyler silt loam	3 008	.5			
Wheeling silt loam	2,816	.5	Total	609,536	

Dekalb Loam.

The soil of the Dekalb loam, to an average depth of 8 inches, consists of a light-brown to gray silt loam, usually very mellow and loamy. The subsoil from 9 to 15 inches is lighter in color and more compact, but similar in texture to the soil. Occasionally the subsoil is a silt loam to 20 or 24 inches, but usually becomes heavier at about 15 inches, below which it is a brownish-yellow to yellow compact silty clay to clay loam. Brown, gray, and red mottlings are found throughout the lower subsoil. When wet the subsoil is plastic, but when dry the silt content is sufficient to make it friable. The characteristic feature of the subsoil is the soapy feel, due to the soapstone in the formation from which the type is derived. Small mica flakes are also thickly interspersed throughout the subsoil. At a depth of 4 to 6 feet the Dekalb loam rests on a mass of broken shale and sandstone fragments, beneath which is the bed rock. Scattered over the surface and through both soil and subsoil are small shale and sandstone fragments, but these are never numerous enough to interfere with cultivation. In many parts of the type stones are almost entirely absent. The soil is not difficult to cultivate, and when properly handled there is no trouble from puddling or baking.

With the exception of a few small areas in the southwestern part of Tyler County, the Dekalb loam is confined to Marshall County, and is best developed in the northern half, where the ridges and hilltops are broader and the surface is not so badly eroded by streams. This type is found only on flattened hilltops and wide ridges, where the rate of

weathering of the underlying rocks is more rapid than the erosion. On the steeper slopes erosion carries away the soil as rapidly as it is formed and thus exposes the subsoil and underlying rock fragments. Such areas were mapped as Meigs clay loam. These two types naturally merge into each other, no distinct divding line being possible. The farmers have recognized the difference between them, and very often the fences separating the cultivated land from the pasture land are the dividing lines between the Dekalb loam and the Meigs clay loam. The topography of the Dekalb loam is such as to furnish ample drainage.

In this area the Dekalb loam is derived directly from the underlying shales and sandstones of the Dunkard formation of the Coal Measures. The fine-grained shales and sandy shales predominate, giving this type a heavy subsoil. The original timber growth consisted largely of red and white oak, hickory, poplar, maple, and beech. There was also some chestnut. Practically all of the type is cleared at present.

With the exception of Brooke clay loam, the Dekalb loam is the most productive upland soil in the area, and is well adapted to all of the farm crops grown in this region. In order of importance, the crops are hay, corn, wheat, and oats. Hay yields 1 to 2 tons per acre, with an average of about 1½tons; corn from 30 to 60 bushels, with an average of 40 bushels; wheat 10 to 25 bushels, with an average of 12 to 15 bushels; and oats 20 to 40 bushels, with an average of 30 bushels per acre. Some potatoes, fruit, and vegetables are grown, mostly for home consumption.

The farmers well recognize the fact that to prevent erosion and to maintain the productive power of the soil it must be kept in grass as much as possible. The usual rotation is corn, wheat, and hay, the land remaining in meadow or pasture from three to six years. A field is thus in corn not more than one year out of five or six.

Some of the farmers have used commercial fertilizers to a slight extent, principally on the wheat, but they say that after once fertilizing a field more and more must be added each year to maintain the yields, and for this reason the use of

commercial fertilizers has been practically abandoned. Stable manure is used in small quantities and gives excellent results. However, as only a few animals are kept on the farms the quantity of manure produced is very limited. A few farmers near the cities find it profitable to haul manure from the livery stables. It is important that all available manure be preserved and applied to the soil.

The northern end of the area, where the Dekalb loam is the prominent soil, is the most prosperous from an agricultural standpoint. The most desirable upland farms of the area are those which contain a large percentage of this type for the general farm crops and a sufficient area of Meigs clay loam for pasture.

The average results of mechanical analyses of fine-earth samples of the soil and subsoil of this type are given in the following table:

Mechanical Analyses of Dekalb Loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand	Very fine sand.	Silt.	Clay.
		P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
17675, 17677	Soil	0.2	2.4	1.3	3.0	8.9	65.6	17.9
17676, 17678	Subsoil	.9	3.0	1.9	5.6	11.6	45.9	30.7

Dekalb Silt Loam.

The soil of the Dekalb silt loam is uniformly a light-brown mellow silt loam with an average depth of about 8 inches. The subsoil to a depth of 36 inches or more is either a very light brown or a pale-yellowish material, varying in texture from a silty loam to a silty clay loam. The soil is quite similar in texture to that of Meigs clay loam, but the subsoils of the two types are very different both in texture and color. Sometimes small fragments of sandstone and sandy shale are found in the soil and subsoil and scattered upon the surface, but this is not a conspicuous characteristic of the type, and rock fragments are never numerous enough to interfere with plowing.

The Dekalb silt loam is not a widely distributed soil, being usually found only in small areas. In the present survey it generally occurs upon narrow ridges or in small shelf-like positions 100 feet or so above the larger streams. It is a residual soil derived from the weathering of some of the heavier, massive sandstone strata of the Dunkard series, and the usual topography is nearly level to gently rolling and in a few places slightly hilly. It is a well-drained soil and absorbs moisture well. It is slightly droughty, however, in a dry season.

The original forest growth was chestnut and oak. At some time or other all of the type has been under cultivation. It is not considered an especially good soil for any particular crop, but when handled carefully and well manured it is a fair soil for all general farm crops of the region. Corn yields from 25 to 60 bushels per acre, oats from 20 to 50 bushels, wheat from 10 to 25 bushels, and potatoes from 50 to 150 bushels. Apples, cherries, plums, berries, and garden vegetables all do well, but are grown only for home use, the same being true for strawberries and raspberries. It is believed that the growing of strawberries, and raspberries early potatoes, and vegetables for market would prove profitable on this soil.

In the early days of the settlement of the region the Dekalb silt loam was not so rapidly taken up and cleared as the limestone soils to the north in Burke and Ohio counties or as the Dekalb loam nearer by. This was due largely to the general recognition of the fact that soil derived from sandstone is usually not as productive as that derived from limestone or marly or limy shale. Sheep raising never was popular upon this soil, for the reason that bluegrass does not thrive upon it.

The soil is slightly acid or "sour," and could be improved by applications of lime and manure and by the growing of clover. At present clover does not obtain a good stand and soon dies out. As the type is not of large extent it has no great influence upon the general agricultural conditions and value of farm lands in the area.

The following table gives the results of mechanical analyses of fine-earth samples of the soil and subsoil:

Mechanical Analyses of Dekalb Silt Loam.

Number	Description	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
17136	Soil	0.1	1.1	1.5	10.7	9.5	62.6	14.3
17137	Subsoil	.1	1.1	1.5	12.9	12.2	52.3	19.7

Wheeling Silt Loam.

The soil of the Wheeling silt loam to an average depth of 12 inches is a loose, mellow, brown or yellow-brown silt loam, often containing some fine sand. The subsoil from 12 to 36 inches varies from a silt loam to a clay loam, but is usually a brownish-yellow to yellow, compact silt loam. Below 24 inches it sometimes contains considerable fine sand, and in places becomes nearly a pure fine sand at 36 inches. A part, if not all, of the type is underlain by sand and gravel at varying depths below 3 feet.

The Wheeling silt loam is confined to the higher terraces along the Ohio River, the largest and most typical areas occurring on the second bottoms, usually on the same level or slightly lower than the Wheeling gravelly loam. In some localities there is no distinct terrace separating the Huntington loam from the Wheeling silt loam, and here the dividing line between these two types is indistinct. Narrow strips of the Wheeling silt loam are sometimes found between the Wheeling gravelly loam and the foot of the hills, and other areas are located on a still higher or third terrace, as at Steelton, 3 miles north of New Martinsville. Wherever the soil occurs as a high terrace bordering the foot of the valley hills it is usually considerably eroded by the small streams and drainage from the bordering hills, its characteristic level topography is lost, and it becomes gently rolling and in places irregular in surface. Where this is the case the soil is lighter in color and is slightly more sandy than

the average of the type. On account of elevation above the river it is not overflowed, and its position, together with the gravelly and sandy substratum, gives fairly good drainage. However, near the base of the hills, where the drainage water collects, there are narrow areas so low and wet as to be entirely unfit for cultivation. If drained, these areas would be as productive as the rest of the type.

The Wheeling silt loam is an alluvial deposit of the Ohio River, being laid down after the glacal gravel was carried in, but at a much earlier date than the deposition of the Huntington loam, and at a time when the waters of the Ohio River were at a higher level than at present. Since then the soil has become weathered and has lost the characteristics of a first overflowed bottom:

The Wheeling silt loam has all been cleared and is under cultivation. It is one of the most productive soils in the area, being well adapted to potatoes, corn, wheat, and hay. Oats are produced to a slight extent. Potatoes yield from 150 to 225 bushels per acre, with an average of 175 bushels; wheat 15 to 25 bushels, with an average of 18 bushels; corn 50 to 80 bushels, with an average of 65 bushels, and hay 1 to 2 tons per acre. One of the rotations practiced by the farmers on this soil, and one which is to be highly recommended, is as follows: Corn or potatoes, wheat, clover, and timothy. The first year the hay is mostly clover; in succeeding years it is mostly timothy. The land is left in grass three years or more, which practice has proved beneficial. Stable manures give excellent results, but commercial fertilizers are not used. The farmers living on the bottom lands of the Ohio River are prosperous and well to do. Their farms, containing some hill land, sell for $80 to $100 an acre. The bottom land alone could not be bought for less than $150 an acre.

The following table gives the average results of mechanical analyses of the soil and subsoil of the Wheeling silt loam:

Mechanical Analyses of Wheeling Silt Loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
17142, 17695	Soil	0.2	1.0	0.6	5.3	8.1	69.3	14.8
17143, 17696	Subsoil	.0	.1	.3	7.7	13.4	59.1	19.1

Wheeling Gravelly Loam.

The soil of the Wheeling gravelly loam has an average depth of about 8 inches and consists of a brown loam usually containing considerable fine gravel and coarse sand. Local variations occur in which the soil contains considerably more than the average quantity of silt, or where the sand content is rather high, in such places the interstitial material ranging from a silty loam to a heavy sandy loam. The subsoil to a depth of several feet is a light-brown or yellowish gravelly loam. The gravel particles vary in size from one-fourth of an inch to 4 inches in diameter and consist largely of waterworn shale and rounded fragments of the harder rocks. Occasionally these shale and rock fragments are strewn over the surface, but never to a sufficient extent to interfere with cultivation. On the whole, the type is a loose, porous soil, easily handled, and never too steep for tilling.

The Wheeling gravelly loam is confined to the terraces of the Ohio River and occurs usually as long, narrow strips whose elevation above the low water of the river ranges from 40 to 80 feet. Its topography varies from nearly level to rolling and hilly. The loose, open nature of the subsoil insures good natural drainage, which over the hilly portion of the type is rather excessive. This type consists of reworked material brought from the glacial region to the north when the volume of the river was greater than now. The sand, gravel, and stones found beneath the surface represent approximately the character of the original deposits. The surface soil, however, has been more or less modified by weathering of the gravel and by an accumulation of organic matter since deposition, thus making it a fairly good soil for

general agriculture and trucking. It was originally covered with hardwood common to the region, but none of this forest is now standing. It was one of the soils first cleared in the early days, because it offered fine sites for buildings.

The Wheeling gravelly loam is better adapted to corn than any other general farm crop, the yields averaging about 45 bushels per acre. The yield of wheat ranges from 10 to 25 bushels, with an average of about 15 bushels, and of hay usually not more than 1 ton per acre. All general farm crops do better in a fairly wet season than in a dry season, as this soil is somewhat inclined to be droughty because of the loose, open, gravelly nature of the subsoil.

The soil is used to a limited extent for early truck crops, and judging from observation in this as well as in the Wheeling area it is evident that trucking on a more extensive scale would prove successful, especially as the large markets along the river are so near. Irish potatoes do especially well and yield on an average about 125 bushels per acre. Apples would no doubt do well, as would also plums, cherries, and pears. The soil needs careful attention in order to maintain its productivity. Barnyard manure is the only fertilizer used, and where applied in sufficient quantities the results are all that could be desired.

The Wheeling gravelly loam is not an extensive type, but its convenient location with respect to markets and its adaption to truck, small fruits, and berries gives it some importance. Owing to its location along the river and the possibility of its future demand for factory sites, this type is held at figures usually beyond the reach of small farmers.

The results of mechanical analyses of fine-earth samples of the soil and subsoil of the Wheeling gravelly loam are given in the following table:

Mechanical Analyses of Wheeling Gravelly Loam.

Number.	Description.	Fine gravel	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct*	*P. ct.*	*P. ct.*
17689	Soil	8.5	15.3	13.6	9.0	3.0	35.7	14.0
17690	Subsoil	10.4	24.2	20.9	9.9	4.0	18.2	12.8

Wheeling Sandy Loam.

The Wheeling sandy loam consists of about 10 inches of light-brown sandy loam of fine to medium texture, underlain by a yellowish or lighter brown, rather incoherent sandy loam or sand to a depth of 30 inches, below which it often becomes a sticky sandy loam. Owing to its loose loamy nature it possesses good natural drainage and is an easy soil to till.

The Wheeling sandy loam occurs as a terrace of the Ohio River, and is found in areas sufficiently large to be shown upon the map in only two localities—around Moundsville and west of Graysville. As the type is largely covered by the city there is no need of discussing it from an agricultural standpoint. A full discussion of the origin of the type and its especial adaption as an apple soil may be found in the Report of the Soil Survey of the Wheeling area, West Virginia.

The results of mechanical analyses of samples of the soil and subsoil of this type are given in the following table.

Mechanical Analyses of Wheeling Sandy Loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
17693	Soil	0.5	2.1	6.5	41.0	9.2	35.1	6.2
17694	Subsoil	.0	.4	3.6	42.7	10.9	34.5	7.6

Tyler Silt Loam.

The Tyler silt loam is a variable type, the different phases being mapped together on account of the small extent of each. The soil to a depth of 10 inches consists of a dark-gray or brown mellow silt loam, underlain to 15 inches by a lighter gray or yellow silt loam. From 15 to 36 inches the subsoil varies from yellow or yellow-brown compact clay loam to a heavy plastic clay. In some places the subsoil i sa yellowish sticky sandy clay, while in others, as along Middle Island Creek.

it is a heavy silt loam, and below 24 inches contains considerable fine sand. The subsoil is often mottled gray and brown, has a soapy feel, and contains numerous small mica flakes. Part, if not all, of the type is underlain by rounded and flattened sandstone gravel, which is also scattered over the surface in a few places. Beneath the gravel is the bed rock upon which the soil was deposited by the stream. In a few places where erosion has carried away the soil the rock is exposed at the surface.

The Tyler silt loam is confined to the second bottoms along the larger tributary streams of the Ohio River, the largest areas being found along Middle Island Creek. These terraces are from 20 to 100 feet above the level of the stream and are never overflowed.

The areas of Tyler silt loam, at one time level, have been more or less dissected by streams and gullies caused by the drainage water from the slopes. Seepage and drainage water collects on the greater part of the areas, and the drainage conditions are very poor. This gives the soil the local name "crawfish land."

The Tyler silt loam is of alluvial origin, being deposited by the streams when their waters were at a higher level than at present. Some of the type near the base of the hills may be partly colluvial in origin.

The original tree growth, principally beech, has all been removed. When cultivated, about 35 bushels of corn, 25 bushels of oats, and from 1 to 1¼ tons of hay per acre are produced on this soil. It is not well adapted to wheat. On account of the lack of drainage nearly all of the type is in meadow or pasture. Thorough underdrainage and liberal applications of stable manure would greatly increase the yields of all crops.

The following table gives the average results of mechanical analyses of fine-earth samples of the soil and subsoil of the Tyler silt loam:

Mechanical Analyses of Tyler Silt Loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
17138, 17687	Soil	0 2	1.5	1.2	6.5	7.0	66.6	16.4
17139, 17688	Subsoil	.1	.8	1.0	6.9	10.5	54.8	25.2

Huntington Loam.

The Huntington loam to an average depth of about 12 inches consists of a brown or dark-brown loam, underlain to a depth of 30 inches or more by a lighter colored, somewhat heavier loam. Throughout both soil and subsoil there is considerable very fine sand. There is much variation in the soil, often within short distances. Where the drainage conditions are poor the subsoil is apt to be drab-colored. Very often there is no distinct line of demarcation in color between soil and subsoil, the gradation from dark brown at the surface to light brown or yellowish at 30 inches being imperceptible. Usually there are numerous very fine mica flakes in both soil and subsoil. The soil is mellow and easily worked when dry.

The Huntington loam occurs as first bottoms along the Ohio River and its larger tributaries. Its usual topography is flat, with a slight fall toward the stream, and it is never cut or eroded. It is subject to several overflows each year, especially during the spring months, but after planting and during the growing season there is little danger of damage from floods. Both surface and underground drainage are fairly good. Only a few depressions are seen where artificial drainage would be beneficial.

As found along the Ohio River, the Huntington loam consists of a mantle of recent alluvial material spread over the gravel deposits of the Glacial period. In places the wash from the adjoining hills contributes to its formation, and in general this soil is still in the process of upbuilding, as each overflow deposits a thin layer of loam and organic matter washed from the uplands. As found along the larger tribu-

tary streams, it also consists of a deposit of recent alluvial material washed from the hills, but instead of resting upon a deposit of gravel, as along the river, it usually rests upon bed rock.

None of the original hardwood timber is now standing. In the early days the type was in great demand as a general farming soil, being regarded then, as now, as an especially strong soil for corn. The present yield of corn ranges from 50 to 100 bushels, with an average of about 60 to 70 bushels per acre. It is also very well adapted to potatoes, the yield ranging from 75 to 150 bushels per acre. Hay yields from 1 to 2 tons per acre, and this is considered a very desirable soil for this crop as well as for pasture. Sometimes the yield of wheat is fair, but the type is not well adapted to that crop. In favorable seasons it is a productive soil for almost any crop, and because of the frequent overflows it does not need any fertilizer. Nearly all of the type is cleared and under cultivation, but there are a few trees still growing upon it, these being, in the order of their importance, sycamore beech, elm, walnut, willow, and tulip. It would be an excellent soil for truck were it not subject to overflow.

The following table gives the results of the mechanical analyses of the soil and subsoil of this type.

Mechanical Analyses of Huntington Loam.

Number	Description.	Fine gravel.	Coarse Sand.	Medium sand	Fine sand.	Very fine sand.	Silt.	Clay.
		P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct*	*P. ct.*	*P. ct.*
17681	Soil	0.0	0.3	0.4	7.9	13.9	54.1	22.7
17682	Subsoil	.0	.5	.7	4.7	16.2	52.9	24.3

Huntington Fine Sandy Loam.

The soil of the Huntington fine sandy loam to an average depth of about 12 inches is a fine sandy loam varying in color from light brown to dark brown and in small areas to nearly black. The subsoil to a depth of 36 inches or more is about the same in texture as the soil, but is lighter colored,

although in places it seems to contain nearly as much organic matter as the soil. The organic matter in both soil and subsoil is accounted for by the fact that small fragments of limbs, bark, leaves, and other debris in the flood waters of the Ohio River were deposited with the fine sand.

The soil is easy to plow and cultivate, being mellow and having little tendency to pack or bake. The elevation of the type above low water in the river is usually less than 30 feet, and consequently a large proportion of it is under water every spring and sometimes later in the year. In the present area the type is found principally upon the small islands of the Ohio River, but it occurs also as long, narrow strips bordering the banks of the river. In these latter locations the type is somewhat higher lying than the area back of it, forming a natural levee. The soil is alluvial in origin and is still in the process of formation.

None of the hardwood timber which originally covered this soil is now standing. Where the soil is accessible and occurs in large areas it is in great demand for the production of corn and truck crops, though in the present area practically none of it is used for extensive trucking. Corn yields on an average about 45 or 50 bushels per acre. Usually wheat is not a safe crop, because of the liability of its being drowned out. Oats do well some years, but are liable to rust. Hay yields on an average from three-fourths ton to 1 ton per acre. It is an excellent soil for Irish potatoes, as was shown farther up the river in the Wheeling area. Cabbage yields about 300 barrels per acre. Besides the above-mentioned crops, asparagus, tomatoes, onions, radishes, and lettuce, may also be produced with profit.

Because of its limited extent and its principal occurrence upon rather inaccessible islands, in the river, the type has no great influence upon the general agricultural conditions and values of land in the present area. It is of importance, however, because of its especial adaptation to truck crops, its nearness to market, and its apparent inexhaustible productivity, renewed with each overflow of the river. It might be well to adopt some system of intensive trucking

upon the islands and arrange for the transportation of the products to the near-by markets by water.

The following table gives the results of mechanical analyses of the soil and subsoil of the Huntington fine sandy loam:

Mechanical Analyses of Huntington Fine Sandy Loam.

Number	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand	Silt.	Clay.
		P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
17685	Soil	0.0	1.4	8.4	39.6	12.0	30.9	7.6
17686	Subsoil	.0	.5	6.9	37.4	9.9	35.1	10.4

Meigs Clay Loam.

The soil of Meigs clay loam is rather variable because of its steep location and the influences of the underlying outcropping formations of soft sandy shale and brittle red clayey shales. The soil, however, is usually a silty loam ranging in color from brown to yellowish, with an average depth of about 8 inches. The subsoil is likewise rather variable in texture, but usually it is a silt loam or loam to a depth of 18 inches and the color is lighter than that of the soil. From 18 to 36 inches it is usually a clay loam or clay varying in color from yellowish to reddish. The red color is always due to the presenc of the soft red shales which often outcrop along the steep slopes, and wherever these are present the subsoil has a soapy feel when rubbed between the fingers. Another characteristic of the subsoil is that it nearly always contains some coarse sand. Very often the subsoil rests upon shale and disintegrated rock fragments at a depth varying from 20 inches to 4 feet, their nearness to the surface depending upon the steepness of the slope and the amount of erosion which has taken place. Scattered throughout both soil and subsoil and strewn upon the surface are usually many small soft sandstone and shale fragments, though these, as a rule, are not present in sufficient amounts to interfere with cultivation.

This is one of the most widely distributed types of soil encountered, and is well developed in all parts of the area except in Wetzel County. It is derived from the red shales and soft sandstones and sandy shales of the Dunkard series, and the rate of erosion is approximately equal to that of the weathering. The soil carries a relatively large proportion of loose, incoherent, micaceous sandy material, the product of a partial weathering of the micaceous sandstone fragments below.

The most constant—and, in fact, the only constant—characteristics of this type are its steep, broken topography and content of shale and sandstone fragments, and therefore it really represents more a condition than a type of soil. Except in areas where there is no better farming land, it is not cultivated very extensively, being better adapted to pasture than to cultivated crops. Where cultivated it requires much care to prevent erosion, and even with terracing and contour cultivation the fields are often damaged. On the whole, it is believed that this soil should be kept in permanent pasture or mowing lands, as continued cultivation has in many cases rendered the land worthless even for pasture.

In the northern and northwestern parts of the area the Meigs clay loam occupies the slopes intermediate between the rounded hilltops of Dekalb loam and the slopes at the bottom of the gorges or valleys. In the vicinity of Cameron and St. Joseph, where this is the prevailing type, it occupies the long, steep hillsides and the narrow ridges. Drainage is excessive over most of this type, and as the derivative rocks are usually only 2 to 4 feet from the surface the land is droughty. The bed rock is arranged horizontally, so there is little downward percolation and seepage areas are frequent.

The soil is not adapted to the production of a wide range of crops, although general farm crops are grown on it to a considerable extent in areas where it is the predominating or the better soil. Hay usually does quite well, as it is not much affected by drought. The fine-earth material seems to be quite productive. It is claimed that with proper attention this soil can be made to give a good bluegrass sod. A

few very good bluegrass pastures were seen, and these were obtained by seeding to Kentucky bluegrass and allowing the grass to grow for two, or possibly three years, without interruption. On some portions of the type orchards and vineyards would probably do well.

It is believed that this soil should never be planted to any cultivated crop like corn. Its greatest value lies in its use as permanent pasture. It is recommended that orcharding and grape growing be given a careful trial. The prevalence of the locust suggests that this tree might be grown for ties, poles, and posts.

Brooke Clay Loam.

The soil of the Brooke clay loam is a brown or dark-brown heavy loam or clay loam with an average depth of about 8 inches. The subsoil to a depth of about 20 niches, is yellowish in color and a little heavier than the soil. Below this to a depth of 3 feet or more the texture remains a heavy clay, but the color often grades gradually from yellowish to drab. Small fragments of gray or bluish-colored limestone and limy shale are often scattered over the surface and through both soil and subsoil.

This type occurs only in a few small patches in the northern part of Marshall County. In Brooke and Ohio counties to the north, as shown in the report on the Wheeling area, this soil is very important not only in extent, but because of its production of profitable farm crops. The limestone formation from which it is largely derived, however, dips along Wheeling Creek, and for that reason very little of the type was met with in the Middlebourne area.

For a fuller description of the type and its especial adaptation see the report on the Wheeling area.

Upshur Clay.

The Upshur clay usually consists of 7 inches of reddish-brown or red clay loam or red clay, underlain to a depth of

36 inches or more by a heavy, tenacious, impervious red clay. There are sometimes small patches in the fields, however, which consists of about 3 inches of gray silt loam, underlain to about 7 inches by a reddish-brown heavy silty clay loam, and below this the usual subsoil.

The type is a very difficult one to till because of its stiff, tenacious character, and is spoken of locally as "cold, wet, late land." In dry weather it has a tendency to bake and is difficult to handle, except in case of the more loamy spots described above, which remain mellow and retain moisture well. In wet weather it forms a deep, sticky mud in the roads, and in dry weather these roads are very hard and rough until packed and worn down by travel or smoothed over with a road machine.

The Upshur clay is found principally in small, unimportant areas in the southern part of the survey. It usually occupies the tops and slopes of small hills and narrow ridges and sometimes occurs as a band extending around the hill, the rocks from which it is derived apparently extending through the hill horizontally.

The surface is generally steep and hilly, but occasionally it is more level, and in such locations the soil is more loamy and better adapted to general farm crops. The soil has a tendency to wash and gully badly, which is due in part to the impervious nature of the subsoil, which prevents it from absorbing rain water readily.

The Upshur clay is a residual type derived from the soft, marly red shales of the Dunkard series. The red color of the soil is not due to recent oxidation, but to the red color of the original sediment forming the Dunkard shales. There are often nodules of limestone and iron ore included in this formation.

The native vegetation consisted of hardwoods, principally oak, hickory, beech, and maple. Practically all of the soil has been cleared of this original growth, but a great deal of it has been abandoned and allowed to gully and to grow up to brush and briers. Much of it is used for pasture with satisfactory results. When carefully handled it is a fair soil for

corn and wheat, but too heavy for potatoes, truck, or fruit. Wheat yields from 10 to 20 bushels per acre and corn from 20 to 50 bushels, but the yield of oats is low.

The following table gives the results of mechanical analyses of the soil and subsoil of this type:

Mechanical Analyses of Upshur Clay.

Number,	Description.	Fine gravel.	Coarse sand	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
17140	Soil..	0.0	0.2	0.4	1.6	1.5	74.7	21 3
17141	Subsoil	.0	.1	.2	1.1	1.5	50 2	46.2

Rough Stony Land.

In Marshall County the areas of Rough stony land are especially well developed on the hills bordering the Ohio Valley, but in Wetzel and Tyler counties land of this character is of wider distribution and not confined to the river hills.

The surface soil is rather variable, the differences depending upon the steepness of the slope and the character of the sandstone or shale immediately underlying. Usually the surface few inches consists of a light-brown silt loam or loam containing varying quantities of shale and sandstone fragments. Very often the surface soil rests directly upon fragments of the underlying sandstone or upon the soft marly shale, but usually the underlying formations are farther below the surface, and to a depth of a foot or two there is a loam or a clay loam material intimately mixed with sandstone fragments. In favored places along the slopes there are often small patches of a deeper soil and subsoil.

The Rough stony land is derived from the same formations as Meigs clay loam, and hence the fine-earth material is quite similar. The chief difference is that this type has more unweathered shale and sandstone fragments in it and a steeper and more broken topography, being in the main too steep and stony for profitable general agriculture, though

considerable of it is cleared and farmed, especially in localities where there is no better land. Throughout the type there are small areas protected from erosion which have a good soil and can be farmed with reasonable profit, notwithstanding the fact that they are isolated by steep rocky slopes and difficulty is had in removing the crop from the fields. Landslides are very common in the Rough stony land areas, sometimes starting at the top of the hill and stripping everything to bed rock to the bottom of the hill. More often, however, the slides move a few feet or a few rods at most. These naturally produce a rough, uneven slope, with many exposed bare spots, which are often too steep even for a stand of grass.

Rough stony land represents a condition where the rate of erosion is equal to or greater than the rate of weathering, the result of which is that the more resistant sandstone strata often form a succession of conspicuous terraces around the steep slopes. The hard horizontal layers of rock form the steeper parts of the terrace, while the soft sandy shale and marly red shales weather more rapidly and form the more level parts. Narrow level strips along the terraces are often cultivated and the crop yields are moderate. Very fair yields of corn are sometimes obtained upon the steeper slopes for the first year, but they usually are so badly washed and eroded in the second year as to be valueless. By cultivating a narrow strip following the contour of the hill and leaving a narrow strip of sod land above and below, the farmers are often able to grow crops upon a considerable portion of steep, hilly land which it would at first appear to be impossible to cultivate. Most of the type, however, has been left in timber and in many places the timber line represents the boundary between this and other soils.

The Rough stony land is located along the bluffs of the river and along the lower slopes of the narrow V-shaped valleys of the larger streams. The drainage basin of Fishing Creek is practically all occupied by this type. Along the outer bends of the larger streams are almost vertical bluffs, showing, however, no prominent ledges, except along Fishing Creek, where the massive sandstone outcrops.

Rough stony land, like the Meigs clay loam, is derived from the Dunkard formation, which consists of alternating and comparatively thin beds of sandstone and shales.

Summary.

The Middlebourne area is located in the northwestern part of West Virginia and includes Wetzel, Tyler and Marshall counties. In a north and south direction the area is about 45 miles long and from east to west from 12 to 32 miles wide. The entire western boundary is formed by the Ohio River.

The topography is irregular, having the appearance of a mountainous country in miniature. The most conspicuous topographic feature is the narrow, gorgelike valley of the Ohio River in the western part, where the hills often rise to 400 feet in height.

The drainage throughout the area is good, and is principally toward the Ohio River. In many places the surface is quite deeply cut, and erosion has been active.

Several branches of the Baltimore and Ohio Railroad afford excellent transportation facilities, and in addition considerable traffic is carried on by way of the Ohio River. Moundsville, New Martinsville, Sistersville, and McMechen, all located on the banks of the Ohio River, are the principal towns.

The climate is mild, neither the winter cold nor the summer heat being extreme. The average length of the growing season is six and one-half to seven months.

About 60 per cent of the total population are farmers, the remaining 40 per cent being engaged in the various industries, chief among which are the oil and gas industries. The farmers are well to do, but on account of the sale of oil and gas rights are not obliged to work their farms on an extensive scale.

Twelve types of soil were recognized, including the Dekalb, Wheeling, and Huntington series, and several minor types.

The Dekalb loam is found principally in the northern half of Marshall County, and is the most important upland soil. It is principally devoted to sheep grazing, but is well suited to orcharding, truck crops, and dairying.

The Dekalb silt loam, although not suited to general farm crops is an important fruit and truck soil. It is not extensively developed in the survey.

The Wheeling silt loam is one of the most productive soils of the area, and is nearly all cleared and under cultivation. It is well adapted to potatoes, corn wheat, and hay Oats are produced to a small extent. Potatoes yield from 150 to 225 bushels, wheat 15 to 25 bushels, corn 50 to 80 bushels, and hay 1 to 2 tons per acre. Farms consisting of this soil type with some hill land sell for $80 to $100 an acre. but those consisting entirely of this soil can not be bought for less than $150 an acre.

The Wheeling gravelly loam is better adapted to corn than to the general farm crops, the yields averaging about 45 bushels per acre. The yield of wheat ranges from 10 to 25 bushels, while hay yields not more than 1 ton per acre. This soil is well suited to truck, apples. pears, plums, and cherries.

The Tyler silt loam is confined to the second bottoms along the tributary streams of the Ohio River, and is alluvial in origin. When cultivated it yields about 35 bushels of corn, 25 bushels of oats, and from 1 to 1½ tons of hay to the acre. It is not well suited to wheat. On account of lack of drainage it is mostly in pasture. Thorough underdrainage and liberal applications of stable manure would greatly increase the yields of all crops.

The Huntington loam is an especially strong soil for corn, where it lies along the river and larger creeks. On the terraces just above the overflow lands it is well suited to truck crops and fruit, as well as the general farm crops. Corn yields from 50 to 100 bushels, potatoes from 75 to 150 bushels, and hay from 1 to 2 tons per acre.

The Huntington fine sandy loam occupies small islands in the Ohio River or occurs as narrow strips along the river

banks. It is particularly well suited to corn and truck crops, although it is seldom found in very large tracts. Corn yields on an average 45 to 50 bushels per acre and hay from three-fourths to 1 ton. Wheat is not safe on this soil, as it is liable to be drowned out. Oats do well some years, but are liable to rust. The type gives good yields of Irish potatoes and cabbage, as well as asparagus, tomatoes, onions, radishes, and lettuce.

Meigs clay loam in point of productivity is a very desirable type for all farm crops. On account of its liability to wash if cultivated it should either be kept in sod or apple orchards should be planted. The growing of locust posts would prove profitable.

The Brooke clay loam is a very valuable soil for general farming, but its area is limited. The Upshur clay occurs in small patches, and is best suited for pasture. When carefully handled it is a fair soil for corn and wheat, but too heavy for potatoes, truck, or fruit. Rough stony land has little agricultural value and should be kept in forest. The growing of locust trees for posts should prove profitable upon this land.

APPENDIX.

LEVELS ABOVE MEAN TIDE IN THE MARSHALL-WETZEL-TYLER AREA.

Baltimore and Ohio Railroad, Main Line.

		Feet.
Burton	Wetzel	1070
Littleton	Wetzel	974
Boardtree	Marshall	1105
Bellton	Marshall	888
Cameron	Marshall	1048
Easton	Marshall	970
Rosbys Rock	Marshall	775
Moundsville	Marshall	642
Benwood	Marshall	650
Wheeling	Ohio	647

Ohio River Branch, B. & O. R. R.

		Feet.
Glendale	Marshall	648.4
Moundsville	Marshall	642.2
Round Bottom	Marshall	645.5
Hornbrooks	Marshall	645.2
Chestnut Hill	Marshall	644.2
Captina Island	Marshall	643.4
Powhatan	Marshall	646.3
Cresaps	Marshall	642.1
Underwood	Marshall	642.0
Cresaps Grove	Marshall	640.5
South Cresaps	Marshall	640.6
Foster	Marshall	643.2
Whittaker	Marshall	644.1
Woodland	Marshall	640.3
Franklin	Marshall	641.2
Clarington	Marshall	637.3
Wells Pit	Marshall	636.6
Proctor	Wetzel	636.4
Alexander	Wetzel	634.6
Maud	Wetzel	634.7
Boresville	Wetzel	632.0
Bridgeman	Wetzel	632.0
New Martinsville	Wetzel	633.7
Sardis	Wetzel	628.4
Paden	Wetzel	629.9
Padens Valley	Wetzel	630.0
Stewarts Crossing	Tyler	630.2
Sistersville	Tyler	649.6
Wells	Tyler	637.4
Cochranville	Tyler	629.8
Davenport	Tyler	627.4
Hays	Tyler	625.5
Friendly	Tyler	624.3
Blaine Station	Tyler	623.9
Long Reach	Tyler	624.4
Selman	Tyler	622.3
Bens Run	Tyler	621.8

West Virginia Short Line Survey B. & O. R. R.

Stations.	Elevations.	
	Top of rail.	Low water.
	Feet.	Feet.
West end of Tunnel	1077	....
West end Fishing Creek, 1st crossing (on David Talkington)	990	950
West end of Talkington Run crossing	963	922
West end Fishing Creek, 3rd crossing (on J. W. Starkey)	903	873
West end Fishing Creek, 4th crossing (on Anderson Cain)	872	857
West end Fishing Creek, 5th crossing (at Smithfield)	883	820
West end Fallen Timber Creek crossing (on Edgell heirs)	823	811
West end Fishing Creek, 7th crossing (at Arches Fork)	819	801
West end Fishing Creek, 8th Crossing (on Lewis Wyatt)	802	782
West end Fishing Creek, 9th crossing (on Alpheus Wyatt)	792	772
West end Fishing Creek, 10th crossing (at Morgan Low Gap)	770	749
West end Buffalo Creek crossing	749	731
West end Wyatt Run crossing (at Madison Baker's)	737	728
West end Fishing Creek, 12th crossing (below Amos Lowe's house)	731	707
West end Fishing Creek, 15th crossing (1 mile above Pine Grove)	723	701
West end Fishing Creek, 16th crossing (at Pine Grove)	718	695
West end Piney Fork Creek branch crossing (on Long & Wiley)	698	680
West end Crow Run crossing (on John Lantz)	690	677
West end Brush Run crossing (opposite Reader)	689	676
West end Fishing Creek, 17th crossing (just above Long Point)	687	660
West end Fishing Creek, 18th crossing (between tunnels)	685	650
West end of State Road Run crossing (on Long Heirs)	682	665
West end Fishing Creek, 19th crossing (above Porters Falls)	678	650
West end Fishing Creek, 20th crossing (on Aaron Morgan)	673	640
West end Fluharty Run crossing (opposite Minnie)	646	632
Ohio River R R. track at Junction, just below New Martinsville	629	....
Low water, Ohio River, at Bowman, 2 miles below New Martinsville	....	601

ELEVATIONS ABOVE TIDE IN THE MARSHALL-WETZEL-TYLER AREA, DETERMINED BY THE U. S. GEOLOGICAL SURVEY.

The following elevations of the U. S. Geological Survey determined and marked in Marshall, Wetzel, and Tyler counties are classified by the counties in which they were established. Many of them were published in Volume I (a) of the West Virginia Geological Survey (pp. 565-579) and some are copied directly from that volume. Some have been slightly changed by recent adjustments of the U. S. Geologigal Survey. In this report they are given in their revised form. Concerning the accuracy and value of these levels Dr. I. C. White says the following[1]:

"The Topographic branch of the U. S. G. Survey, in connection with, and aided by the U. S. Coast and Geodetic Survey, is covering the entire United States with a net work of precise elevations. As a result of this precise leveling, many of the old levels and bench marks accepted for many years as accurate by the railroad officials, civil engineers, and others, have been proven erroneous, often to the extent of several feet. In this readjustment of elevations, th U. S. G. Survey finds it necessary to change slightly, as a higher degree of accuracy is attained, some of its own former standard elevations, and thus those given of the same bench mark for one year may differ slightly from that given in a later publication. The railroad, civil, and mining engineers are now almost unversally adjusting their levels to those given by the U. S. G. Survey, especially since the recent plan has been adopted of placing bronze tablets marked with the elevations, in conspicuous positions every few miles in each quadrangle surveyed."

MARSHALL COUNTY

Cameron and Littleton Quadrangles. Based on the 1903 adjustment of precise levels. Leveling in 1902 and 1903 by Geo. L. Gordon.

1. Volume I (a), p. 558, W. Va. Geol. Survey.

Moundsville East Along Public Roads via Limestone and Beula Station to Rocklick.

	Feet.
Moundsville, (U. S Engineer's bench mark 101 B) Marshall county courthouse; in front of building, 17.2 feet east of center of doorway, on top of water table of foundation of	690.510
Limestone, dwelling of R. H. Peters, (only brick building in Limestone), front of foundation, top stone, 2.7 feet northwest of center of door, bronze tablet marked "1377 GRAFTON"	1376.784
Pleasant Valley, 0.4 mile southeast of; brick dwelling, (J. W. Cunningham's), stone at front gate, top of, chiseled square	1317.05
Beeler Station, first step above stone platform, northeast corner, chiseled square	1356.54

Rocklick South Along Public Roads and Baltimore and Ohio Railroad via Cameron and Woodruff to Bellton

	Feet.
Rocklick, 0.3 mile south of; south side of southeast corner of schoolhouse, second stone, aluminum tablet marked "1464 GRAFTON"	1463.805
Cameron, 1.8 miles northeast of; M. E. Church at northeast angle of crossroads, at south end of retaining wall, top of, chiseled square	1074.79
Cameron, west end of brick public school building, water table 0.9 foot north of southwest corner, bronze tablet marked "1170 GRAFTON"	1169.864
Woodruff, 0.7 mile northwest of; west end of stone culvert, center of top of, chiseled square	1015.98
Bellton, 0.1 mile north of; railroad bridge No. 136, north abutment, southeast corner, 2.7 feet above bridge seat, bronze tablet marked "888 GRAFTON"	887.579

Bellton West Along Public Roads via Adaline to Lynn Camp.

	Feet.
Kausooth post office, 2.4 miles west of; bridge over Big Run, top of west abutment, 12.5 feet right of center of bridge, chiseled square	768.40

Lynn Camp North Along Public Roads and Baltimore and Ohio Roalroad via Meighen and Rosbysrock to Moundsville.

	Feet.
Meighen, at schoolhouse No. 5, east side, 8 feet from southeast corner, top stone of foundation, bronze tablet marked "691 GRAFTON"	690.667
Rosbysrock, at Big Grave Creek; iron bridge over, northeast abutment, 12 feet southeast of center of bridge, 1 foot below bridge seat, bronze tablet marked "779 GRAFTON"	778.326
Rosbysrock, 4 miles northwest of; railroad bridge No 146 over Big Grave Creek, south abutment, top of northwest corner, chiseled square	680.75
Moundsville, Marshall County Court House; south front of, 17.2 feet east of center of doorway, bronze tablet marked "690 GRAFTON"	689.284

Lone Oak Schoolhouse North Along Public Roads to Hazeldell Schoolhouse.

(Single spur line).

	Feet.
Hazeldell or Irish Ridge Schoolhouse, center of southwest cornerstone; bronze tablet stamped "1322 GRAFTON"	1321.542

Bellton South Along Highway to Bannen.

	Feet.
Bannen, 1.1 miles southwest of; schoolhouse, sub. dist. No. 9, 8.8 feet southwest of west corner; iron post stamped "1398 GRAFTON"	1398.160
Bannen, 2.8 miles southwest of; schoolhouse at forks of road, stone steps, bottom step, west end; chiseled square	1376.98

WETZEL AND TYLER COUNTIES.

New Martinsville, Littleton, Mannington, West Union, and Centerpoint Quadrangles.

Based on the 1903 adjustment of precise levels. Leveling on the New Martinsville quadrangle in 1903 by R. E. McFadden, and in 1904 by Geo. L. Gordon; on the Littleton, West Union, and Centerpoint quadrangles in 1903 by Geo. L. Gordon; and on the Mannington quadrangle in 1902 by J. W. Hodges.

Proctor Southeast Along Highways to Halls Mills.

	Feet.
Baltimore & Ohio railroad bridge No. 317 over Proctor Creek, in west end of south abutment, bronze tablet marked "632 GRAFTON 1903"	632.114
Marion post office, 0.2 mile east of; opposite Marion Moore's store building, south of creek, on stone, chiseled square	881.62
Bebee post office, stone steps leading to Lewis Feias house, bottom step, chiseled square	1259.75

New Martinsville Southwest Along East Side of Ohio River to Sistersville, thence Southeast to Middlebourne.

	Feet.
New Martinsville, in county court house, facing Main street near main entrance, bronze tablet marked "630 GRAFTON 1903"	630.282
Lively crossing flag station, top of rail	630.
Mandota flag station, top of rail	628.1
Paden station, in front of, top of rail	630.
Stewarts crossing, in front of station, top of rail	633.
Sistersville, City Hall and post office building, south side in sill, bronze tablet marked "649 STBNVL"	648.606

	Feet.
Iron bridge over Pursley Creek, at foot of hill, top stone of southeast foundation, T. P.——circle——.....	736.97
Luzon post office, 0.5 mile southeast of; east side of road, opposite Kellar's old store building, square on stone.....	1055.41
Luzon post office, 2.5 miles southeast of; northeast abutment of iron bridge over Point Pleasant Creek, near where it empties into Middle Island Creek, on top stone, chiseled square.....	684.56
Middlebourne, northeast corner of Sheriff's residence, in stone over cellar window, north of front entrance to house, aluminum tablet marked "744 GRAFTON 1903"	745.162

Middlebourne Northeast Along Highway to Reader, thence Northwest Along Baltimore and Ohio Railroad (Short, Line) to New Martinsville.

	Feet.
Polard post office, 0.5 mile northeast of; on rock north of road near Elk Creek, square on.....	745.46
Conaway post office, in southeast corner of James W. Mayfield's cellar, facing post office, aluminum tablet marked "840 GRAFTON 1903".....	841.033
Reader, 2 miles northwest of; southwest abutment of large railway bridge No. 121, over Fishing Creek, chiseled square on.....	680.73
Flanagan flag station, in front of; top of rail.....	678.
Reader, 3 miles northwest of; on southwest abutment of bridge No. 110 over Fishing Creek, chiseled square..	676.
Porters Falls 0.6 mile northwest of; on southeast abutment of small bridge, chiseled square.....	670.64
Minnie flag station, in front of; top of rail.....	647.2
Minnie flag station; 360 feet west of; on southwest abutment of railway bridge No. 74, chiseled square....	646.28
Bard, telegraph office, top of rail.....	641.2
Minnie, 6 miles northwest of; on north end of small railway culvert, over Bank Run, chiseled square.....	621.24

Galmish Southwest Along Highway to Lima, thence West to Blue.

	Feet.
Galmish, (pump station), 0.2 mile east of; Baltimore & Ohio railroad bridge No. 159 over Piney Creek, on south end of west abutment, 6th step from top, chiseled square.....	687.97
Piney, cliff between forks of creek, near the corner, bronze tablet marked "790 GRAFTON".....	790.039
Lima, 0.37 mile west of; north side of road, outcrop of rock bronze tablet marked "769 GRAFTON".....	769.235
Blue, 0.2 mile east of; dwelling, stone steps in front of, second from bottom, east end, chiseled square.....	734.23

Middlebourne Southeast Along Highway toward West Union.

	Feet.
Middlebourne, 0.2 mile southwest of; iron bridge over Garren's Run, east abutment, southwest corner, chiseled square	681.48

	Feet.
Blue, 0.3 mile southeast of; iron bridge above Indian Creek at mouth, northwest abutment, south corner, bronze tablet, marked "707 GRAFTON"	707.193
Blue, 1.6 miles southeast of; McElroy Creek, iron bridge over, northwest abutment, south corner, chiseled square	716.66
Wilbur, 0.15 mile northwest of; 6.5 miles southeast of Blue, east side of road, outcrop of rock, bronze tablet marked "973 GRAFTON"	974.012

Bellton Southwest Along Highways via West to Halls Mills, thence South to Reader, thence Along Highways and Railroad East to Lot, thence Northeast Along Highway to Littleton.

	Feet.
Bannen, 1.1 miles southwest of; schoolhouse, sub dist. No. 9, 8.8 feet southwest of west corner, iron post marked "1398 GRAFTON"	1398.160
Bannen, 2.8 miles southwest of; schoolhouse at forks of road, stone steps, bottom step, west end, chiseled square	1376.98
Silverhill, at Laurel Run, bridge over west abutment, south end, chiseled square	1133.96
West, forks of road at; east angle, outcrop of rock, bronze tablet marked "1106 GRAFTON"	1106.218
Beebee Post Office, bottom step of stone stairway to house of Louis Feias; chiseled square	1205.75
Halls Mills, 5.3 miles southwest of West; north side of road near Mr. Thomas Adams store and dwelling, outcrop of rock, bronze tablet marked "774 GRAFTON"	774.396
Reader, county bridge over Fishing Creek, south abutment, northeast corner, aluminum tablet marked "693 GRAFTON"	693.676
Reader, 0.8 mile southeast of; B. & O. R. R. bridge No. 145 east abutment, north end, top stone, chiseled square	687.893
Galmish 0.2 mile east of pump station, B. & O. R. R bridge No. 159 over Piney Creek, on south end of west abutment, 6th step from top; chiseled square	687.97
Pine Grove, north fork of Fishing Creek, covered bridge over north abutment, southwest corner chiseled square	712.58
Pine Grove, 1.8 miles southeast of; B. & O. R. R. bridge No. 195 north abutment bridge seat, east end, chiseled square	723.07
Jacksonburg, at railroad crossing, top of rail	747.3
Jacksonburg, 0.1 mile southeast of; Buffalo Run, B. & O. R. R. bridge over, northwest abutment, south corner of bridge seat, bronze tablet marked "746 GRAFTON"	745.958
Jacksonburg, 6.2 miles northeast of; .05 mile southeast of Lowman's east side of road, outcrop of rock, aluminum tablet marked "839 GRAFTON"	839.220
Lowman's 5.4 miles northeast of; Uniontown, .08 mile southwest of, south side of road, outcrop of rock, aluminum tablet marked "1133 GRAFTON"	1133.320

Uniontown, 1.0 miles northeast of bridge over Knob Fork Run, northeast abutment, east end, chiseled square 1052.74
Uniontown, 4.7 miles northeast of; Small Hollow, bridge over northeast stone of abutment, top of, chiseled square 1179.38

Jacksonburg Southeast Along Baltimore and Ohio Railroad via Smithfield to Wallace.

Feet.

Jacksonburg, 1.3 miles southeast of; railroad bridge No. 236 over Fishing Creek, northwest abutment, northeast end of bridge seat, chiseled square..... 765.93
Jacksonburg, 3.5 miles southeast of; railroad bridge No. 260 over Fishing Creek, west abutment, north side. top of, chiseled square..... 803.13
Jacksonburg, 4.75 miles southeast of; northwest corner of Railroad culvert, chiseled square..... 811.95
Smithfield, 0.2 mile northwest of; railroad bridge No. 293 over Fishing Creek, north abutment bridge seat, southeast corner, bronze tablet marked "829 GRAFTON" 828.787
Smithfield, at station, railroad crossing, top of rail.... 836.1
Folsom, 1.6 miles northwest of; railroad bridge No. 307 over Fishing Creek, south abutment, second stone fro mtop, chiseled square..... 870.62
Folsom, railroad crossing between station and post office, top of rail..... 952.5
Rinehart, 3.6 miles northwest of; 0.2 mile northwest of tunnel station, railroad culvert, southwest of, chiseled square 1051.61
Rinehart, 0.05 mile southeast of; railroad culvert over Mud Lick Run, northwest corner of, aluminum tablet marked "1059 GRAFTON" 1058.895
Rinehart, railroad crossing..... 1068.4
Wallace. Short Line railroad bridge No. 382, near, southeast abutment, southwest corner, chiseled square.. 1032.26

Blue Southwest Along Highway to Alma.

Feet.

Alma, 3 miles south of; forks of road, southwest angle, corner of store, top of large rock under, chiseled square 717.25
Alma, 6.5 miles southwest of; 0.34 mile south of Bearsville, northeast side of road, northwest side of hollow, outcrop of rock, bronze tablet marked "839 GRAFTON" 839.349

Middlebourne Southwest Along Highway to Little.

Feet.

Little Post office, on top of east pier south side of large iron bridge over Middle Island Creek, bronze tablet marked "672 GRAFTON 1903"..... 672.187

Along Main Line of B. & O. Railroad.

Feet.

Hundred, crossing at station; top of rail.....1019.
Hundred, 0.1 mile northwest of, in top of bridge seat of northeast abutment of bridge No. 128; bronze tablet stamped "1013 GRAFTON 1902".....1013.276

INDEX

A

Page

Abbreviations of Marshall County Well Owners.... 362
Abrigg, Samuel, No. 1..... 465
Adams, Geo., No. 1..... 106
Adolescence, Geologic..... 34
Ages, Geologic..... 74
Allegheny series 75, 326
Formations of..... 335
Allen, C. J., Nos. 1 and 2... 517
Allen, W. W., No. 1..... 507
Alley, S. T., No. 1..... 80
Allison, J. M., mine 285
Allison, J. M., No. 1..... 375
Alma (Centerville), Acct. of 31
Alvy (Stringtown), Acct. of 30
Anderson, Eliz., No. 1..... 439
Anderson, G. W. T., No. 1.. 107
Anderson, M. V., No. 11.... 456
Anderson, Sarah E..... 110
Anderson borings (See Core tests).
Andy P. O..... 26
Ankrom, J. W., No. 1..... 528
Anshutz Nos. 20 and 12..489, 494
Anticlines, Description of:
Big Moses..... 69
Hundred 63
Littleton 64
New Martinsville..... 68
Sistersville 72
Washington 66
Wick 71
Appalachian coal field, Area of..... 534
Archer, Silas, No. 1..... 138
Arches Fork anticline 454
Arches P. O..... 26
Area of counties..... 1
Armstrong, John, No. 1.... 371

Page

Ash, J. L., No. 1..... 516
Ash, Jas., No. 1..... 525
Ash, Mary, No. 1..... 525
Attleberger, Samuel, No. 3.. 507
Available coal in the area.. 577

B

Baker, J. R., No. 1..... 117
Baker, Isaiah, Nos. 5, 7, and 3.....508, 509
Baltimore & Ohio R. R.... 3
Base-level of streams..... 34
Bates, Elma J., No. 1..... 455
Batson & Co..... 595
Bayard (6th) sand..... 357
Beagle, W. A., No. 1..... 499
Beall, Widow, No. 2..... 399
Bellton (Denver Sta.)..... 17
Bens Run, Coals near..... 496
Benwood, Acct. of..... 13
Benwood limestone..... 297
Berea Grit sand..... 350
Big Injun sand.....347, 350
Big Moses gas well.....511, 512
Big Moses anticline..... 69
Bituminous Coal Co. of Am.. 571
Bixby, W. H..... 53
Blackshere, Wells & Co. No. 5..... 108
Blake, F. B., No. 1..... 447
Blake, Franklin, No. 1..... 446
Blankensop Mfg. Co..... 13
Boggs Run deep well..... 82
Boggs Run Min. & Mfg Co.. 565
Booth, E. A., No. 4..... 460
Boreman, Arthur I..... 10
Boreman, K. S., No. 2..... 505
Bowers, Geo. W., No. 1.... 392
Brant, Mathias, No. 1..... 386

Page

Broadwater, A., Nos. 48 and 47..... 529
Brooke clay loam..... 629
Bruhn, Jno., No. 7 and No. 2.....388, 391
Buck, Henry, coal mine ... 546
Buck, M. A., coal mine.... 547
Buck, J. S., No. 1..... 491
Building stone 592-598
Burchfield sycline 64
Burley, Lindsay, No. 2 384
Burton, Acct. of 24
Burton sandstone 182

C

Cambria Mining Co..... 318
Cameron, Acct. of 16
Campbell, P. P., No. 1.... 402
Camp P. O., Well near.... 516
Carboniferous formations .. 75
Thickness of 124
Carpenter, H. J., No. 1.... 491
Carter Iron Co..... 25
Carter Oil Co..... 29
Carse Heirs No 6..... 527
Cassville Plant Shale 249
Centerville (Alma), Acct. of. 31
Chambers, Lewis, No 2.... 389
Chemical Analyses:
Benwood limestone..... 300
Brick clay, Moundsville.. 584
Brick clay, New Martinsville 585
Draw slate, Pittsburg coal 587
Sewickley limestone 309
Washington, Middle, limestone 210
Clapp, F C.....353, 434
Classification of Rocks 74
Clay and clay industry.... 582
Clays, Analysis of 584

Coal Analyses:
Dunkard 193, 578
Fish Creek.....189, 578

Page

Freeport, Lower..... 337
Hostetter 183, 578
Jollytown 198, 578
Nineveh 178, 578
Pittsburg—14, 573-574, 579-580
Sewickley, Lower ..305, 579
Sewickley, Upper 305, 307, 579
Table of 578, 579
Uniontown 290, 579
Waynesburg "A"....234, 578

Coals of the area, Commercial 538
Lower Freeport bed..576-577
Pittsburg bed 565-575
Sewickley bed 561-565
Uniontown bed 558-561
Washington bed 540-553
Waynesburg bed 553-558
Relative position of 539
Summary of available ... 577

Coke Analyses:
By-product 15
Connellsville 15
Cook, Geo. W., No. 1..... 470
Conemaugh series..... 75
Description of 319
Formations of 325
Conley, J. A., No. 1..... 436
Conner, P. M., No. 1..... 389
Corbly, A. L., No. 5..... 522
Core test wells:
Abersold (Proctor)..... 96
Anderson, G. W. T. (Zinn) 279
Anderson, M. V. (Jacksonburg) 276
Anderson (Whetstone run) 266
Ewing, W. W., (Viola P. O.) 263, 573
Glenova (Ohio Co.)..322, 328
Hammond (Powhatan Sta.) 269
Headley, F. C. (Pine Grove) 275
Higgs, C. (Franklin Sta.). 94

	Page
Jacksonburg, Near	276
Kocher near Maud P. O.	470
Long Reach (Thos. Moore)	123
McFarland, T. B. (Powhatan)	91
Mobley (Jas. Shuman)	278
Peters, Geo. (Claringston Sta.)	573
Pine Grove (J. N. Camden)	103
Wagner, Ed.	271
Wells, C. P. (Proctor)	270
Workman, Nellie (Graysville)	92
Cosgray, Hugh, No. 1	433
Cow Run sand, First	342
Cow Run sand, Second	344
Cox, D. H., No. 1	449
Cox, J. T., No. 1	134, 376
Creighton Slope mine	261
Crow, Isaac, No. 2 and No. 1	87, 395
Cross, W. J., No. 1	440
Cunningham, David M., No. 4	462
Cunningham, W. L., No. 1	430

D

	Page
Dakon, Ebenezer	105
Davis, Silas, No. 1	371
Dawson sand (Maxton)	346, 502
Dean, P. O.	26
De Haas, Willis	8
Dekalb loam	614
Dekalb silt loam	616
Denver Station (Bellton), Account of	17
Deepest oil well geologically (W. Va.)	390
Devonian formation	76
Diamond drill holes (See Core test wells)	
Divine, Wm., No. 1	431
Dobbs, J. F.	390
Dorsey, Ed, No. 1	382
Dorsey, Upton, No. 1	376
Dotson, Finley, No. 1	524
Downing Heirs, Maria, No. 1	370
Drainage basins, Description of	40
Draw slate, Pittsburg coal, Analysis of	587
Dunham, Geo., No. 1	470
Dunkard coal	192
Analysis of	193
Dunkard sand	343
Dunkard series	75, 124
Age	249
Description of formations	166
Fossils in	251, 255
Sections of	126-165
Thickness of	106
Type section of	126
Duquesne Glass Works	26
Duty, A. W., No. 3	521

E

	Page
Earnshaw P. O.	26
Eddy, Jas., coal mine	546
Effect of geologic structure, etc.,	532
Eljer Co.	17
Elk Fork terrace	71, 500
Elliot, E. J., No. 1	427
Elm Grove limestone	247
Endicott P. O.	26
Erosion, Geologic	33

F

	Page
Fairmont Coal Co.	276, 278, 574
Fall of streams	40
Farrell, J. T., No. 1	500
Farrell, Wm., No. 1	501
Fifth (McDonald) sand	357
Fifty-foot sand	352
Finney (Loudenville) syncline	67
First oil well, Sistersville field	359

Page

Fish Creek 42, 51
Quarry in, Littleton 593
Tests of 594
Fish Creek coal 150, 187
Fish Creek sandstone 185
Fishing Creek 44, 51
Fleming, Ellen, No. 1..... 396
Flood Records, Ohio River.. 58
Fluharty, N. C., No. 3..... 500
Fluharty, Wm., No. 9..... 462
Folger, Israel, No. 3..... 503
Folmar, Geo. P., No. 1..... 77
Fontaine, Wm. 251
Formations, Geologic 75
Fostoria Glass Co. 12
Fourth sand 356
Francis, Ed., No. 1..... 380
Freeport coal, Lower..... 336
Analysis of 337
Friendly, Account of 30
Fronaphel, A. J., No. 2..... 394
Fulton green shale 296
Furbee & Bros., D. N.,
No. 4 513
Furbee, Jas., No. 1..... 452

G

Gallagher No. 1..... 379
Gantz sand 351
Garner pool 467
Gartland Heirs, Otis, No. 1.. 383
Gas sand 344
Geologic formations 75
Geologic sections (See Sections)
Gilboy sandstone 287
Quarry in 598
Gillingham, Geo. N., No. 1.. 438
Gilmore coal 172
Gilmore limestone 173
Gilmore sandstone 171
Glass Industry of
Cameron 17
Moundsville 12
New Martinsville 22
Paden City 26

Page

Sistersville 29
Glendale Coal Co. 570
Glen Easton, Acct. of 17
Glover, Alpheus, No. 4..... 519
Gorby Heirs No. 1..... 398
Gorby, Marion, No. 1..... 445
Gorby, V. P., No. 1..... 388
Gordon sand,
Description of..... 354
Table from Pittsburg coal 355
Gordon Stray sand..... 354
Gorrell, J. G., No. 4..... 505
Gorrell, J. J., No. 1..... 526
Goudy, Mack, No. 1..... 469
Grave Creek 42
Gray, H. E., No. 1..... 390
Gray, Wm., No. 5..... 387
Grimsley, G. P.....1, 36, 40,
53, 208, 210, 227, 247,
249, 295, 297, 298, 311,
371, 583, 589, 593, 595,
597, 598
Groves, Jno., No. 1..... 515

H

Hagan, J. P., mine 197
Haines, R. H., No. 1..... 434
Hall, J. M., ... 271
Hall, W. J., mine 234
Harbison quarry 597
Hammond Heirs mine 307
Hardman, O. W. O., No. 2.. 530
Hart Bros. No. 6..... 459
Hart, Wm., No. 1 466
Hastings, Acct. of 23
Haught, Elias, No. 1..... 501
Haught, J. R., No. 1.....463
Hays, Ezra, No. 1..... 459
Headley, G. W., No. 1..... 455
Heinzman, A., No. 1..... 493
Henry, Jas. No. 1..... 401
Hess, David W., No. 1..... 524
Heyer, Chas. 574
Hickman, David, No. 1..... 504
Hicks, G. W., No. 1..... 381

Page

Higgins, Jno., No. 4..... 399
Himelrick, W. H., No. 1.... 426
Hitchman Coal & Coke Co. 318, 568, 570
Hixenbaugh, Henry, No. 1.. 426
Hoffman, J. L., No. 1..... 383
Hoge, W. V., No. 2 and No. 1 .....142, 385
Holmes, Sarah A., No. 5.... 494
Hosack mine (Hitchman)... 318
Hostetter coal 182
Hostutler, David, No. 1.... 422
Hostutler, Jackson, No. 1... 420
Howard Heirs, Brice, No. 1 382
Howard, Lee, gas well 139
Howard, W. S., No. 1..... 396
Huggins, Jno., No. 4..... 467
Hundred, Acct. of 24
Hundred Anticline 63
Hundred coal 215
Hundred sandstone 214
  Microscopical structure... 595
  Quarry in 595
  Tests of 596
Huntington fine sandy loam. 625
Huntington loam 624
Hunt, Mary E., No. 1..... 428

I

Impure coal, Value of 552
Injun sand, Big 347
Iron, (See Steel Industry).

J

Jacksonburg, Acct. of 23
Jemison, Mary, No. 3..... 505
Johnson, Mary E., No. 1.... 506
Johnson, Moses, No. 1..... 118
Jolliffe, Ira, No. 1..... 280
Jolliffe, P. O. 26
Jollytown coal 197
  Analysis of 198
Jollytown sandstone 196

K

Kennedy, W. J., No. 1..... 463
Kiger, Peter, No. 1..... 437
King, J. G., Nos. 1 and 5.....302, 502
King, Jno., Nos. 1 and 2.. 503
Kinney, Albert, No. 1..... 510
Kirkland, J. L., No. 1..... 470
Knowlton, Jas. H. 573
Kocher, J. A., core test well 470
Kocher, J. A., No. 1..... 469
Kodol P. O. 26
Kyle, J. W., No. 1..... 511
Kyle oil pool (Tyler) ..511, 512

L

Lacox, Lititia, No. 1..... 448
Lady, Jno., No. 2..... 498
Lantz, Jno., No. 1..... 464
Lantz, Samuel, Nos. 1 and 8 457
Lantz, Zue, No. 2..... 446
Leach, Lem, No. 1..... 380
Leasure, J. T., No. 3..... 120
Lemasters, J. A., No. 1..106, 443
Lemley, C. McC..... 573
Levels above tide 636-643
Lightner, S., No. 1..... 377
Liming, Jacob, No. 1..... 424
Little Washington coal..... 226
Little Waynesburg coal 286
Littleton, Acct. of 24
Littleton anticline 64
Littleton Stone Co. 593-594
Location of coal samples... 580
Loneberger, Jno., No. 5.... 527
Long, E. B., No. 8..... 527
Long, Rufus, No. 1..... 444
Loudenville (Finney) syncline 67
Lough, C. C., No. 3..... 387
Lough, E. P., No. 1..... 380
Lower Washington limestone 213
Lower Freeport coal 336, 576
  Analysis of 337
  Quantity of available ... 577
Lyon, C. S., No. 1..... 499

M

Page

Magnolia Brick Co., ... 585
Magnolia Window Glass Co.. 22
Maloy, J. R., No. 1..... 504
Mannington sandstone 226
Maple, Jno., No. 4..... 423
Marietta sandstones 215
  Quarry in 597
Marion P. O. 26
Marshall County Bank,
  No. 1 .....143, 384
Marshall County, Description
  of 5
  Towns of 7
Marshall County,
  Coal production of 535
  Coal production by mines 537
  Men employed in mines... 537
Marshall County well records 360
  By magisterial districts:
    Cameron 380
    Clay 398
    Franklin 401
    Liberty 381
    Meade 392
    Sand Hill 370
    Union 370
    Washington 378
    Webster 375
  Table of 364
Martin, Samuel, No. 1..... 100
Mason Coal Works 568
Mason and Dixon Line..... 2
Mason, J. P., No. 1..... 522
Massey, R. C., Nos. 1 and 2.. 497
Maxton sand 346
McCabe quarry, Sistersville. 598
McCormick, Sarah, No. 1... 501
McCoy, J. B., Nos. 15
  and 12 .....122, 488
McEldowney, Jno. C., Jr. ... 18
McFadden, G. S., ... 12
McIntire, J. L., No. 1..... 519
McMechen, Acct. of 15
McMechen, Mrs. A. C. 15, 588
Meek, F. B., ... 249
Meredith, G. L., No. 1..... 492
Meredith, J. A., No. 1..... 520
Mehrley No. 10 489
Meigs clay loam 627
Meighen, Dennis, No. 1..... 434
Mercer, Jno. No. 1..... 523
Meyer, W. C. 573
Middlebourne, Acct. of 30
Middlebourne syncline 70
Middle Island creek 46, 51
Middle Washington limestone 209
Miller, S. C., No. 1..... 441
Mills, Jno., Nos. 3, 30, 88,
  48, and 71.....457-459
Minor, Jennie, No. 1..... 394
Monadnock, Definition of .. 33
Monongahela series:
  Description of 258
  Formations of 282
  Sections of 259-281
  Type section of 259
Morgan, I. D., No. 11..... 452
Morris, Wm., No. 1..... 521
Mound Coal Co. 570
Mounds, Indian:
  Cresap Bottom 19
  Mammoth (Moundsville). 8
  New Martinsville 18
  Whittaker (Woodlands).. 19
Moundsville, Acct. of 7
Mountain State Stone Co. .. 596
Mount Morris limestone ... 244
Murphy sand 341
Myers, David L., mine 283
Myers, W. W., No. 1 114

N

National Tube Co. 14
Newman, Wm., No. 3 439
Newman, S., No. 3..... 438
New Martinsville, Acct. of.. 21
New Martinsville anticline.. 68
New Martinsville Glass Mfg.
  Co. 22

Page

Nineveh coal 175
Analysis of 178
Nineveh limestone 178
Nineveh sandstone 174
Nineveh syncline 65
Nolan, Henry, Nos. 7 and 2 461
Nolte, Jos., No. 6..... 393

O

O'Brien, Thos., No. 2..... 463
O'Day, Jas., No. 1..... 437
Ohio River:
Cross sections of 55, 331
Description of 53
Flood records of 58
Stages at Wheeling 56
Transportation on 3
Ohio River Railroad 4
Ohio Valley Glass Co. 26
Oil and Gas Development:
Early history 359
Marshall county 360
Wetzel county 402
Tyler county 472
Oil and Gas sands of W. Va.:
Description of 339
Distance table from top of Pittsburg coal 340
O'Neil, J. W., No. 1..... 98
Osborne, E. J., No. 1..... 497
Otte, Jno. No. 2..... 378
Owens, H. D., No. 3..... 529

P

Paden City, Acct. of 25
Panama Coal Mining Co. .. 572
Pan Handle of W. Va..... 1
Patterson Window Glass Co. 17
Peneplain, Definition of.... 34
Penetentiary, W. Va., State 13
Peterson, G., No. 5..... 384
Phillips, B. F., No. 1..... 381
Phillips, Jos., A., No. 1.... 421
Physiography of Marshall, Wetzel and Tyler..... 32

Page

Pierpont Estate No. 1..... 506
Pine Grove, Acct. of 23
Piney P. O. 26
Pittsburg coal 313, 565
Analyses of 14, 573-574, 579-580
Clay seams in 569-570
Commercial mines in..565-572
Quantity of available.... 574
Sections of 565-572
Thickness of 364, 404, 476
Western boundary line of 456
Pittsburg sandstone 312
Poe, J. L., No. 6..... 529
Pogue, L. E., No. 1..... 425
Porters Falls P. O. 26
Potteries of
Cameron 17
Middlebourne 30
Pottery clays 588
On Mrs. A. C. McMechen land 588
Pottsville series 75
Pratt, W. W., No. 1..... 516
Proctor Creek 44
Proctor sandstones 167
Proctor syncline 68
Prospective oil and gas territory 533
Prosser, C. S. 250
Province, Jos., No. 1..... 447
Pt. Pleasant Creek..... 38
Pultney mine (Ohio)..... 318
Pyle, B. L., No. 1..... 332

Q

Quantity of Coal in area:
Lower Freeport bed 577
Pittsburg bed 574
Sewickley bed 562-565
Uniontown bed 559-561
Washington bed 552
Waynesburg bed 556-558

R

Railroad levels in the area 636

Page
Railroads, Prospective 5
Reader, Acct. of 25
Redstone coal 309
Redstone limestone 311
Reilly, Geo. V., No. 1..... 460
Renner, Wm., No. 1 422
Resseger, Elias, coal mine.. 543
Richmond, E. J., No. 1.... 372
Richter, G., No. 2..... 389
Riggs, J. S., No. 2..... 530
Riverside plant of National Tube Co. 14
Road materials 589-592
Robinson, B. F., Nos. 1 and 2 .....530, 531
Robinson syncline 69
Roome-Iseman No. 8..... 488
Rosbys Rock 87
Rough stony land 631
Ruble, Taylor, No. 1..... 454
Rush, J. H., No. 3..... 442
Rush Run sandstone 191
Russell, E. P., No. 4..... 120
Rutan, Jno., No. 1..... 392
Rymer, F. L., No. 1..... 507

S

Salt sand 345
Salt water well, Great 499
Sands, Oil 339
Santee, Jno., No. 5..... 423
Scannahorn, Aaron, No. 1.. 492
Schwab Co., The J. A. 13
Sections, Geologic:
Aleppo Township (Greene Co., Pa.) 128
Arches Fork 108
Bellaire, Ohio 260
Bellton (Denver Sta.).141, 142
Benwood 268
Big Moses 116
Big Run of Indian Creek 114
Boardtree 140
Boggs Run 82
Brown P. O. 153
Page.
Burton 110
Cameron, Southeast of .. 139
Chaplin Hill, Wheeling .. 262
Clarington Station 95
Conemaugh series, General 322
County farm 130
Creighton mine 261
Doolin Run (New Martinsville) 99
Dunkard Creek (Pa.).... 126
Falls Mills 163
Franklin Station 93
Glen Easton 136
Grandstaff Run 77
Graysville 91
Hog Run 145
Kittanning, Pa. 327
Littleton 148
Long Reach 123
Lynn Camp 87
Majorsville 80, 264
Majorsville, West of 132
Majorsville, Southwest of. 265
McKim 118
McMechen, East of 131
Middlebourne 117
Middle Grave Creek 83
Moundsville 85
New Martinsville, Ohio side 158
New Martinsville, W. Va. side 101
Owlshead Knob (Jacksonburg) 107
Owlshead Knob (Tyler County) 162
Paden City 159
Pine Grove 103
Piney 152
Polard 161
Powhatan Station 89
Proctor Creek (Marion).. 98
River Hill (New Martinsville) 101
Rocklick 138

Page.
Sections, Geologic—Continued.
Rosbys Rock 86, 143
Scotts Run 259
Sims Run 147
Sistersville 120
Sistersville (turnpike) ... 121
Smithfield 151
Steels Run (Clyde) 106
Steelton 156
Toms Run 135
Washington County (Pa.) 127
West P. O. 154
Wileyville 105
Wolf Run 133
Semet-Solvay Co. 14
Sewickley coals 302, 561, 572
Analysis of 305, 579
Quantity of 562-565
Thickness of 562
Sewickley limestone 308
Sewickley sandstone 301
Shiloh syncline 72
Shough, Winona, No. 1.... 419
Showalter, T. J., No. 1.... 442
Shriver, Sol., No. 1..... 425
Sidell-Moore No. 1..... 443
Silver Hill P. O. 26
Sines, Barney, No. 1..... 419
Sistersville, Acct. of 28
Sistersville anticline 72
Sistersville Boiler Works ... 29
Sistersville oil pool 359
Sixth (Bayard) sand 357
Smith and Furbee No. 1.... 514
Smith, Catharine, mine 304
Smith, Clark, No. 1..... 532
Smith, H. L., No. 1..... 453
Smithfield, Acct. of 22
Smithfield terrace 64, 452
Snodgrass, W. G., No. 1.... 424
Soil survey of the area.... 599
Agriculture 605
Climate 603
Description of the area... 599
Soils 611
Summary 633

Page.
Sole, David, No. 2..... 441
Speechley sand 358, 390, 397
Spencer, Moses, Nos. 1 and 2232 .....511, 512
Spencer, M. W., No. 1..116, 513
Statistics of coal production. 535
Stealey, Anderson, No. 1.... 509
Stealy, M. H., No. 1..... 502
Steel Industry of:
Benwood 14
Paden City 25
Sistersville 29
Steelton 26
Steels Run Oil field..... 440
Steelton, Acct. of..... 26
Steenrod No. 1..... 576
Stein, Gertrude, No. 1..... 393
Stevens, Jno., No. 20..... 453
Stevenson,
J. J. 185, 209, 294, 315
Stewart, Peter, No. 1..... 293
Stewart Stamping Co. 12
Stoneking, Eliz., No. 1..... 334
Stone, R. W. 353, 434
Stout, J. S., No. 2..... 454
Stream piracy 35
Stringtown (Alvy), Acct. of. 30
Stringtown oil pool 360
Stringtown terrace 64
Structure, Geologic 59
Details of 62
Methods of representing.. 60
Suburban Brick Co. 583
Summary of available coal.. 577
Synclines:
Burchfield 64
Londenville (Finney).... 67
Middlebourne 70
Nineveh 65
Proctor 68
Robinson 69
Shiloh 72

T

Tayor, Helma, No. 1..... 431
Taylor sandstone 173

Page.
Teagarden, Wm., Nos. 2 and 1 .....432, 433
Terraces:
River 48
Creek 50
Thickness of coals:
Lower Freeport bed 577
Pittsburg bed ..364, 404, 476
Sewickley bed 562
Uniontown bed 559
Washington bed 551
Waynesburg bed 557
Thirty-foot sand 352-353
Thistle, Dr. J. L., Nos. 8, 9, and 10 490
Thomas, Geo. W., No. 1.... 430
Thompson, H. R., No. 1.... 467
Throckmorton, Geo. F., No. 1 428
Tidal elevations 636-643
Topography of land area.... 48
Trader, Jno., No. 1..... 467
Transportation, History of .. 3
Tyler Brick and Tile Co. ..30, 586
Tyler County 26
Towns of 28
Tyler County well records.. 472
Centerville district 520
Ellsworth district 500
Lincoln district 475
McElroy district 510
Meade district 525
Union district 493
Table of, summarized ... 476
Tyler silt loam 622

U

Underwood and Orr No. 3.. 517
Underwood, David, Nos. 19 and 20 518
Underwood, Zane, No. 2.... 515
Uniontown, Acct. of 26
Uniontown coal 289
Analysis of 290, 579
Quantity of 559-561
Thickness of 559
Uniontown limestone 294
Uniontown sandstone 288
United States Stamping Co.. 12
United States Three Barrel Gun Co. 12
Upshur clay 629

V

Villiers, Harvey, No. 1..... 435
Virginia Oil and Gas Co. ... 375

W

Wade, Frank, No. 1..... 444
Wagner core test well, Ed 271, 542
Wagner, Ed, No. 1..... 273
Washington anticline 66
Washington coal...221, 540-553
Analysis of 543, 550, 578
Quantity of 552
Sections of 541-549
Thickness of 551
Washington "A" coal 218
Washington limestone 207
Washington sandstone 226
Watkins, Z. S., No. 1..... 472
Watson, F. M., No. 1..... 449
Wayman, Fred, No. 1..... 392
Waynesburg coal 282
Analysis of 283, 578-579
Quantity of 556-558
Sections of 554-556
Thickness of 557
Waynesburg "A" coal 231
Analysis of 234
Waynesburg "B" coal 230
Waynesburg limestone 286
Waynesburg sandstone 245
Weight of cu. ft. of coal.... 552
Wells Glass Co. 29
Wells, J. S., No. 1..... 495
West Augusta County 2
West, Jno. W., No. 1..... 394
West P. O. 26
West Virginia Short Line R. R. 4

Page.

Wetzel County, history, etc.. 17
Wetzel County well records. 402
Center district 440
Church district 418
Clay district 435
Grant district 445
Green district 460
Magnolia district 471
Proctor district 466
Table of 404-417
Wharton, Abner, No. 1.... 519
Wheeling Creek 40, 50
Wheeling gravelly loam 620
Wheeling sandy loam 622
Wheeling silt loam 618
Wheeling Steel & Iron Co. 15, 566
White, David 252
White, H. S., No. 1..... 384
White, I. C. ....49, 62, 124, 125, 126, 127, 167, 169, 183, 218, 221, 244, 245, 251, 274, 287, 289, 295, 303, 313, 326, 336, 339, 342, 348, 359, 361, 372, ...379, 387, 552

Page.

White, Jesse, No. 2..... 495
Whitlatch, W. C., No. 1..... 429
Wick anticline 53
Wilcox, S. C., No. 2..... 521
Wiley, Sol. H., No. 1..... 461
Williamson, Adam, No. 6 or 7 494
Wilson Estate, J. S., No. 1.. 531
Wilson, Mary V., No. 1..... 397
Windy Gap coal 169
Windy Gap limestone 167
Winning, Ed, No. 1766..... 465
Wise, J. C., No. 1..... 471
Woodburn, Samuel, No. 1... 514
Woods, J. R., No. 2..... 464
Wright, G. Frederick 53
Wyat, F. E., No. 1..... 390

Y

Yoho, Alfred, No. 1..... 444
Yoho, Jacob, No. 1..... 468
Yoho, Joshua, No. 1..... 386
Young, Jno., No. 1..... 395
Youth, Geologic 32